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MEAT DISHES

THE KITCHEN LIBRARY

Vol. IV

MEAT DISHES

by

COUNTESS
MORPHY

HERBERT JOSEPH

4 Adam Street
Adelphi

THE KITCHEN LIBRARY

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PEACH HALL WORKS TONBRIDGE KENT**

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Methods of Cookery

ROASTING

IN roasting, the object is to preserve in the meat as much of its juices as possible, and this is done by subjecting it at first to great heat, so that the albumen on the surface should coagulate and form a thin crust on the outside, which will prevent the escape of the juices. When this crust or coating has been formed, the meat should then be cooked slowly and at a much lower temperature.

Real roasting can only be done in front of a clear bright fire, the meat being on a revolving spit, or in a Dutch-oven or roasting-jack.

As, however, the word "roasting" has lost its original significance, and baking in the oven has taken its place, I will confine myself to suggesting how this can be done more or less satisfactorily—I make that reservation, as baked meat never has the same delicate flavour as roasted meat. In a closed oven the vapours given off as the surface of the meat is being hardened cannot escape, and the meat is cooked in an atmosphere laden with these, and is not as good as when cooked with a free current of air around it.

One of the first conditions of satisfactory roasting in an oven is that the oven should be very hot for the first 10 to 12 minutes. In the case of a gas oven, it should be lighted at least 15 minutes before the meat is put in. The meat should always be placed on a trivet in the roasting pan. This is most important, as the meat is apt to catch when in direct contact with the pan. Put the meat in a hot oven and do not baste till a thin crust has formed on the surface. When this is done, dredge the meat with salt, and replace in a moderate oven. Frequent basting is essential, as otherwise the meat will be hard and dry. On no account

should water be used for basting. Butter, good fat—the fat should be absolutely fresh—or olive oil, are used for basting, the latter being applied with a pastry brush over the joint, and not poured over like butter or fat. If the meat is liked well-done, allow 20 minutes to the lb.—25 minutes in the case of pork, which should always be cooked through—and 15 minutes if the meat is preferred underdone. The meat can be tested by running a skewer into it; if the juice that oozes out is red, the meat is not sufficiently cooked. If the juice is slightly pink, the meat should be done “to a turn”—an expression which dates from the time when the meat was roasted on a revolving spit.

The gravy can be made by using the natural juices which have escaped from the meat and by scraping the dredgings from the meat pan and diluting with a little boiling water, seasoned with a little salt. As this only makes a very small quantity of gravy, it is advisable to prepare a sufficient quantity beforehand. Brown a few bones and trimmings in a little fat, cover with warm water, and season with salt and pepper, bring to the boil, skim thoroughly, and simmer gently for 2½ to 3 hours. Strain through a cloth before serving. Flour should never be added to gravy.

GRILLING

Good grilling, like real roasting on the spit, is rarely met with nowadays. To be perfect, grilling should be done over a clear charcoal, wood or coke fire. The principle is the same as that of roasting: the meat should be subjected to great heat at first, so that, as the fat melts, the albumen forms a coating which prevents the juices from escaping. The length of time for grilling does not depend on weight, but rather on the thickness of the meat, birds, fish, etc., to

be grilled. Electric grillers are about the best substitute for grilling over a clear fire.

The grill should be warmed and slightly greased before using, the object of this being to prevent the meat, etc., from adhering to it. Whatever is about to be grilled should be seasoned with salt and pepper, and brushed over with a little melted butter or oil. When either electric or gas grills are being used, they should be switched on or lit a few minutes before grilling is started, and, unless otherwise indicated, kept full on during the process of grilling.

Grilled meats should be slightly and pleasantly "charred" outside, and slightly underdone inside, when they will be found to be juicy and tender. It is almost better to under-grill than to over-grill, as in the latter case meat is apt to be dry and tough.

Good grilling is very much a matter of judgment and experience.

BOILING

Although boiling should be one of the simplest and easiest methods of cooking, it is not as simple as it appears at first sight, and often a boiled chicken, for instance, comes to the table looking like a bundle of rags, and a boiled leg of mutton may either be falling to pieces or worse still, hard and tough. The reason for this is that the liquid has been boiling at the wrong temperature, *i.e.*, that it has been boiling too fast. With very few exceptions, everything that is boiled should be *simmered* or boiled *very slowly*, once the liquid has come to the full boil. This point cannot be too strongly emphasized.

In boiling meat which is intended for the table—that is, that is not merely soup meat—always put the meat in boiling water or stock, with a little salt, as the addition of salt demands a higher temperature for boiling than plain water.

The boiling water has more or less the same effect on it as the action of heat in the process of roasting and grilling, and an impervious crust will be formed on the meat which will prevent the juices from escaping. If hard boiling is continued for any length of time, not only will there be this slight and necessary hardening of the surface, but the meat will be hardened through and will be tough and stringy. After putting the meat in boiling liquid, wait till the liquid is on the full boil, and let it boil hard for about 5 minutes. Then lower the temperature considerably and simmer very gently, so that there is a mere ripple on the surface of the liquid.

In the case of meat which is used for the making of soups only, the process is exactly the reverse. The meat is put in cold water, gradually brought to the boil, and then simmered gently for several hours.

FRYING

There are two kinds of frying—deep frying and “dry” frying. For the latter, the French have a distinct word, which is far more descriptive of the process and is not as misleading as the word “frying,” that is—*sauté*, or tossed. I am glad to say that this word *sauté* is gradually creeping into the English culinary vocabulary.

Deep frying involves the uses of an abundance of hot fat—whatever is being fried should literally “swim” in it. The proper pan for this is not always easy to get in this country, and it seems a pity that some enterprising firm should not put such a thing on the market at a reasonable price. It would enable the housewife to fry as efficiently as the chef, and as safely. For frying in an abundance of fat in an ordinary somewhat shallow and long-handled frying pan, is neither satisfactory nor safe. The proper utensil is made of iron and in various sizes, and even in the smaller

sizes is at least 4 inches deep, and is fitted with two small handles and a frying basket with a close mesh.

Of the different fats used for frying, good oil is by far the best, and in the long run more economical, as it can be used many times, if strained, and keeps better than animal fats. The latter are not as digestible as vegetable oil, and a certain amount of grease always seems to cling to things fried in it.

The fat from beef kidney, when absolutely fresh, is also very good, as it can be made very hot without burning. The addition of one-third of veal fat improves it. Lard should not be used for frying, as it is apt to leave a greasy crust on whatever is fried in it, and sometimes has an unpleasant flavour. Dripping is economical, and from this point of view only can be recommended. But it should be used absolutely fresh, and even then it is difficult to do any good and delicate frying in this kind of fat. Even when it has been carefully clarified, it is apt to taste of the source from which it was derived, and whatever is fried in dripping remains greasy. Mutton fat should never be used, as it is apt to leave a tallow-like flavour. Butter, of course, cannot be used for deep frying, as it burns when brought to a high temperature.

Whatever kind of fat is used for deep frying, it should be very hot before anything is put into it—the fat is at the right temperature when a thin bluish smoke rises from it. A good test is to drop a small piece of bread into the hot fat. If it rises to the surface at once and sizzles, the fat is sufficiently hot. Things that are fried in fat which is not sufficiently hot, are never crisp, and become sodden.

In “dry” frying or *sauté*, butter, oil or fat should be used in small quantities—only sufficient to coat the pan, unless otherwise indicated. When very hot, the meat, etc., is put in it, and the pan should be shaken constantly, and if a somewhat thick slice of meat is being *sauté*, the temperature

should be slightly lowered, as the surface is apt to burn before the meat is cooked through. It is advisable to clarify butter before using it for *sautés* or "dry" frying, as this rids it of impurities and things are less likely to "catch."

BAKING

The baking of meat, or "roasting" in the oven, has already been mentioned under the heading of Roasting (see p. 17).

BRAISING AND STEWING

Braising and stewing, which are almost interchangeable terms, should always be done on a very slow fire or in a slow oven, with very little liquid. This liquid, by the slow process of cooking, gradually absorbs the juices from the meat and vegetables, and makes a gravy which is always served with the meat. A common error is to use far too much liquid and to cook too rapidly, the process being thus that of boiling rather than of stewing. Certain stews—such as Irish stew, Navarin and Blanquettes—require careful skimming, or are apt to be greasy.

Although braising and stewing are practically the same, in true braising the utensil should be completely surrounded by gentle heat—in the olden days, hot coals were placed on the lid of the braising pan—and braising should therefore be done in the oven, where the heat is more equally distributed. Whether the stew or braising pan be of iron or earthenware, it should be only sufficiently large to hold the ingredients, somewhat closely packed, and it is essential to have a close-fitting lid. If the pan is too large, more liquid has to be used, and the result is that the meat is not properly braised or stewed and the gravy is thin and watery. The pan is lined with strips of bacon, covered with sliced carrots and onions, and mixed herbs. Allow about 1 oz. each of

carrot and onion to every pound of meat. If a brown stew is wanted, the vegetables and meat should be browned beforehand in a little fat. The meat is placed over the bacon and vegetables, the pan is covered and the whole is simmered very gently for about 20 to 25 minutes, *without the addition of any liquid*, and without touching or disturbing the meat. The meat gradually becomes white, and its juices, as well as that from the vegetables, ooze out gradually and flavour the gravy. In the case of white stews, the meat should not be allowed to brown during this process. Now add about 1 gill of liquid—stock, wine or water, bring to the boil without covering the pan, and reduce to about 1 tablespoon. The gravy will have even more body and will be more succulent if this operation is repeated a second time. Now add the liquid in which the meat is to be cooked, but, in the case of a large piece of meat, such as a joint of beef or leg of mutton, the meat must *not be covered* with the liquid—it should only reach half-way, not more. Season with salt and pepper, cover closely—it is even advisable to put a piece of paper over the pan, so that the lid will fit more tightly, and then put the pan in a slow oven, and simmer very gently and regularly for several hours, the length of time depending on the weight and thickness of the meat. The meat should occasionally be basted with the gravy. To test whether the meat is sufficiently done, prick it with a skewer; if done, the skewer will slip out easily. To serve, the meat is placed on a dish and the gravy is strained over it. If a thick sauce is wanted, a thickening of butter mixed with a little flour can be added. Or else the meat and vegetables can be sprinkled with a little flour, before the liquid is added to the stew.

The method of braising or stewing which I have described, is the general one, but there are variations and special methods for certain stews which will be indicated in the course of the book.

Beef

BOILED BEEF

THE pieces which are most suitable for boiling are the round, the brisket, silverside and aitchbone. Put the meat, well-skewered and tied, in a saucepan only just sufficiently large to contain it, and barely cover with warm water. Bring to the boil gradually, and remove the scum as it rises. Add 2 or 3 sliced carrots, 1 or 2 large onions, cut in half and stuck with 2 or 3 cloves, 2 or 3 turnips cut in half, a sprig of thyme, parsley, a bayleaf, salt and peppercorns. Simmer gently, and allow 20 minutes to the lb. and 20 minutes over. Serve with a little of the stock poured over the meat, and garnish the dish with the vegetables.

LE BOUILLI (French Boiled Beef)

This is made with either fresh brisket of beef or top rump cooked in bone stock, or water to which a few bones have been added. Put the stock in a saucepan, and when quite warm, but not boiling, add the meat. Bring to the boil, skim thoroughly, and during the process of skimming add occasionally a few tablespoons of cold water, which makes the scum rise to the surface. When the stock is quite clear, add $\frac{1}{4}$ lb. of carrots, 3 ozs. of turnips, 2 large leeks (the white part only), 3 onions (one being stuck with 2 cloves), 1 small stick of celery, $\frac{1}{2}$ oz. of salt, or $\frac{1}{2}$ tablespoon or a little less if coarse salt—*gros sel*—is being used, and 5 or 6 peppercorns. Cover with a lid, but leave an opening, and simmer gently for $2\frac{1}{2}$ to 3 hours, or until the meat is quite tender. Place

the meat on a hot dish, garnish with the vegetables, and strain a few spoonfuls of the stock over it. Sometimes a little *gros sel* is sprinkled over the meat and sliced gherkins are served with it. Tomato sauce, Robert sauce (see pp. 120 and 119), or Béchamel sauce to which some capers have been added and cooked for a few minutes, are the favourite French sauces served with *le bouilli*.

BOILED BRISKET OF BEEF

Lay a few rashers of bacon in a saucepan and lay the meat over them. Brown the meat lightly, turning it occasionally to brown evenly. Remove the bacon, drain off the fat, cover the meat with warm stock or water, and proceed as in the recipe for Boiled Beef (p. 24).

To serve, put the meat on a hot dish, pour a few table-spoons of the strained stock, and serve with a sauce made by browning 1 oz. of flour with 1 of butter and adding $\frac{1}{2}$ pint of the warm stock gradually, and the vegetables, cut in small dice.

COLLARED BEEF

The best pieces to use for collared beef are the thin end of the flank of beef or the ribs, but the former is more generally used. To every lb. of beef, allow 2 ozs. of coarse sugar, 6 ozs. of salt, and 1 oz. of saltpetre. Lay the meat on a dish and rub in the sugar, salt and saltpetre. Let stand in this pickle for 10 days, turning the meat every day and rubbing in the pickle. Bone the meat, removing the gristle and coarse skin, and roll in a mixture 2 tablespoons of finely chopped parsley, 1 tablespoon of minced sage, a bouquet of mixed herbs, $\frac{1}{2}$ teaspoon of pounded allspice, and salt and ground peppercorns. Now roll the meat and tie as tightly as possible in a cloth and boil very gently for 6 hours. When done, remove from the saucepan, put a heavy weight

over it, without removing it from the cloth, and let stand till quite cold.

CORNEB BEEF

Corned or pickled beef is usually bought already pickled. The round of beef is the piece which is used for corned beef.

Put the beef in a saucepan, cover with warm water, bring to the boil, and simmer gently, allowing about 30 minutes to the lb. and 30 minutes over. Let stand in the water till cold.

BOILED BEEF À LA FLAMANDE

Lard $4\frac{1}{2}$ to 5 lbs. of top rump of beef (see p. 124 for larding), and put in a saucepan with $\frac{1}{2}$ lb. of gammon and cover with 3 quarts of warm stock or water. Bring to the boil, and skim carefully. Season with salt and peppercorns and simmer gently, allowing 20 to 25 minutes to the lb. and 20 minutes over. One hour before serving, add 3 or 4 carrots, cut in half lengthwise, the same of turnips, and $\frac{3}{4}$ hour before serving, add a few potatoes and a small cabbage, quartered. To serve, put the meat on a hot dish, garnish with the vegetables, strain a little of the stock over it, and serve with either Horseradish or Tomato Sauce (see pp. 117, 120).

PICKLED BEEF

See instructions for Salting Beef, Hams, etc., p. 110.

HOTCHPOTCH WITH SOUP MEAT (Dutch) (Hutspot met klapstuck)

Ingredients : 1 lb. of fat soup meat, $\frac{3}{4}$ lb. of lean soup meat, 3 lbs. of carrots, 3 lbs. of potatoes, 10 ozs. of onions, 2 ozs. of fat, $1\frac{1}{2}$ pints of water, salt and peppercorns.

Method : Wash the meat and put in warm salted water,

bring to the boil, skim and simmer for 2 hours. Peel the carrots, mince them very finely, and add to the stock after the 2 hours. In another $\frac{1}{2}$ hour, add the peeled potatoes and chopped onions and simmer for another $\frac{1}{2}$ hour till the vegetables are very tender. Add more water during the process of cooking if necessary. But when the dish is ready the water should have completely evaporated. Remove the meat from the saucepan, put on a hot dish, mash all the vegetables with a wooden spoon and put on the dish with the meat.

PRESSED BEEF

Salt brisket of beef is used for this typically English dish. The meat is washed and put in a saucepan with sufficient water to cover. Bring to the boil, skim carefully and add 2 or 3 onions, left whole, 2 or 3 halved carrots, $\frac{1}{2}$ large turnip, a sprig of parsley, thyme, 1 bayleaf, and a few peppercorns. Simmer till the bones can be easily detached from the meat, allowing 30 minutes to the lb. and 30 minutes over. Remove from the stock, drain, and press between two boards or two dishes, placing a heavy weight over the upper board or dish. When quite cold the meat is brushed over with glaze.

BOILED SALT SILVERSIDE OF BEEF

This is boiled in the same manner as unsalted beef (see recipe for Boiled Beef, p. 24). Suet dumplings, boiled in the stock, are served as a garnish with this dish, as well as the vegetables. The paste for these dumplings is made as follows : Put 12 ozs. of flour in a basin with 1 teaspoon of baking powder, a good pinch of salt, and mix with 6 ozs. of finely chopped suet. Add gradually sufficient cold water to make into a stiff paste. Shape into small dumplings and poach in stock or water for about 30 minutes.

BOILED BEEF WITH SAUERKRAUT

Either fresh or salt beef can be used for this dish (see recipe for Boiled Beef, p. 24). Put the beef on a hot dish when done, and garnish with the cooked sauerkraut and strain a little stock over the whole.

SPICED BEEF

Mix 2 teaspoons of black pepper with $\frac{1}{2}$ teaspoon of ground ginger, $\frac{1}{2}$ teaspoon of powdered cloves, and the same of grated nutmeg and mace. Sprinkle freely over a piece of pickled beef (see p. 26), well drained. The meat should then be rolled, bound and skewered into shape. Put in an earthenware casserole with sufficient water and wine barely to cover the meat, cover closely with the lid, and put in a moderate oven for 4 to 5 hours. Remove from the casserole, put the meat between 2 boards, placing a weight over the top board, and let stand till cold.

BEEF, BRAISED OR STEWED

BEEF STEW

A beef stew, in the English fashion, can be done with various cuts from the beef, the most usual being ribs of beef, shin, and steak. The meat can either be left in the single piece, or cut in $2\frac{1}{2}$ to 3-inch lengths. The meat is then browned in butter or hot fat, and a small amount of either stock or warm water is added, brought to the boil and thoroughly skimmed, and a few vegetables, such as onions, carrots, turnips, a bouquet of mixed herbs, salt and peppercorns are added. Cover and simmer till the meat and vegetables are quite tender.

STEWED BEEFSTEAK

For 2 lbs. of steak cut in 1 piece to a thickness of about $\frac{3}{4}$ inch, allow 6 to 8 ozs. of veal forcemeat (see p. 121), 1 pint of stock or water, $1\frac{1}{2}$ ozs. of butter, 1 tablespoon of flour, salt and pepper. Flatten the meat with a beater or rolling-pin, spread the forcemeat over the steak, roll up and tie with tape. Brown the meat in the butter, seasoning with salt and pepper, and, when equally browned on all sides, add the stock or water, cover the saucepan and simmer very gently for 2 hours. When done, put the steak on a hot dish, thicken the stock with the flour, and strain over the meat.

BŒUF CRÉOLE

The characteristic of this dish is that no water or liquid is used. Put 2 or 3 lbs. of rump of beef in an earthenware casserole, on a few slices of fat bacon. Season with salt, pepper and chili pepper, finely chopped, and cover the meat with 2 lbs. of sliced onions and the same of tomatoes. Cover and simmer for $3\frac{1}{2}$ to 4 hours. Serve in the casserole, after having carved the meat.

BEEF À LA BOURGUIGNONNE

Lard 3 to 4 lbs. of top rump with strips of larding bacon (see p. 124) which have been marinated in a little brandy. Put the beef in a deep dish, with 1 or 2 sliced onions, mixed herbs, 1 bayleaf and $\frac{3}{4}$ pint of red wine. Season with salt and peppercorns and let stand for 2 or 3 hours. Remove the meat from the marinade, wipe it with a cloth, and brown in a little butter, being careful to brown equally on both sides. Now add the wine in which it was steeped, 1 gill of veal or chicken stock, and $\frac{1}{2}$ pint of Espagnole sauce (see

p. 116). Add a bouquet of mixed herbs, and 1 tablespoon of mushroom peelings. Cover and cook in a moderate oven for 2½ to 3 hours. Half an hour before the meat is to be served, put the meat in another saucepan, with ½ lb. of pickling onions, previously browned in butter, ¼ lb. of quartered mushrooms, cooked in butter, ¼ lb. of gammon, cut in dice and also browned in butter. Strain the sauce over the meat and simmer for another 30 minutes.

BRAISED BEEF

Put 4 to 5 lbs. of fresh brisket of beef in a saucepan in which it just fits, over 2 or 3 sliced carrots, 1 large leek, 1 or 2 sliced turnips, and 1 stick of celery. Cover the meat with a few slices of bacon, add a bouquet of mixed herbs, and sufficient stock or water nearly to cover the vegetables. Season with salt and peppercorns. Cover with a close-fitting lid, bring to the boil, and simmer gently in the oven for 4 to 5 hours. Half an hour before serving, put the meat in a clean saucepan, strain the sauce over it, and add ½ pint each of carrots and turnips turned with a vegetable scoop about the size of large peas, and browned in a little butter, and a few pickling onions, also browned in butter.

BRAISED BEEF À LA CATALANE (Spanish)

Ingredients : 5 or 6 lbs. of topside or round of beef, ½ lb. of larding bacon, the same of ham, ½ lb. of bacon rashers, 1½ lbs. of onions, ½ lb. of small mushrooms, 1 lb. of French beans, 1 lb. of tomatoes, 2 lbs.^b of potatoes, 3 or 4 carrots, 1 lb. of sausages, 1 glass of red wine, a small glass of brandy, 1 clove of garlic, thyme, marjoram, sweet basil, parsley, 1 or 2 bayleaves, salt, a pinch of nutmeg, peppercorns, butter.

Method : Lard the beef on both sides with thin strips of larding fat and uncooked ham (see p. 124 for larding). Line a large saucepan with the bacon rashers, lay the beef on these, add a little butter, the garlic, sliced onions and carrots, parsley, salt peppercorns and nutmeg. Simmer gently till the meat and vegetables begin to brown, then put in the sliced tomatoes, the red wine and brandy. Simmer again till the wine is reduced, then cover the meat with water, bring to the boil and simmer for $2\frac{1}{2}$ to 3 hours, till the meat is very tender. To serve, put the meat on a hot dish and garnish with the following, all previously cooked : the French beans, sauté with a little ham, the potatoes, cut in small dice and browned in butter, the mushrooms, and the fried sausages. The strained stock is served in a sauceboat.

BRAISED FILLET OF BEEF (1)

Lard $3\frac{1}{2}$ to 4 lbs. of fillet of beef very closely with larding bacon (see p. 124) and place it in a small saucepan, in which it just fits, on a layer of bacon rashers. Add 1 gill of very good stock and 2 tablespoons of brandy. Put on a very quick fire, and as soon as the liquid has come to the boil, baste the meat with it continually for 7 or 8 minutes, while the liquid is reducing. When the liquid has completely evaporated, add $\frac{3}{4}$ pint of hot stock, and 6 tablespoons of white wine, and 1 tablespoon of pork dripping. Season with salt and pepper, bring to the boil, cover, and put in the oven. Simmer gently, allowing 15 minutes to each lb. of meat. Baste frequently. When done, remove the meat from the saucepan, put on a fireproof dish, pour 3 or 4 spoonsful of the sauce over it, and put in a quick oven for a few minutes to glaze it. Strain and reduce the stock in which the meat was cooked and thicken with a little arrow-root or flour.

BRAISED FILLET OF BEEF (2)

Put the larded fillet, well seasoned with salt and pepper, in a roasting pan on a trivet, and pour a little melted butter or fat over it. Put in a very quick oven for 10 minutes, till equally browned on all sides. Meanwhile, slice $\frac{1}{4}$ lb. of carrots and the same of onions in $\frac{1}{4}$ -inch rounds, and brown in a little butter. Now lay a few rashers of bacon in a small saucepan, just sufficiently large to hold the beef, cover with the vegetables and lay the meat over them. Add a bouquet of mixed herbs, and 6 tablespoons of stock. Bring to the boil, and boil till the stock has completely evaporated. Now add $\frac{3}{4}$ pint of stock, put a sheet of buttered paper over the meat, cover with a close-fitting lid, put in a moderate oven, and simmer, basting frequently, and allowing from 12 to 15 minutes to the lb. A few minutes before serving, glaze the meat, as in the preceding recipe, strain the sauce and reduce for a few minutes, but do not thicken it.

BRAISED FILLET OF BEEF WITH MADEIRA SAUCE

Braise the fillet as in the preceding recipe, but serve with a Madeira sauce (see p. 117) to which 3 or 4 tablespoons of the strained sauce from the fillet have been added, and a garnish of potato croquettes.

BRAISED FILLET OF BEEF WITH MUSHROOMS

Braise the fillet as indicated in recipe for Braised Fillet (2), garnish the dish with mushrooms, previously cooked in butter, and serve with a Madeira sauce (see p. 117).

BRAISED FILLET OF BEEF À LA JARDINIÈRE

Garnish the braised fillet with carrots and turnips, boiled and sautés in butter, and cut in rectangles, French beans,

peas, and clusters of cooked cauliflower, and serve the sauce, strained through a sieve, in a sauceboat.

BRAISED FILLET OF BEEF À LA NIVERNAISE

Garnish the braised fillet with turned carrots, boiled and lightly browned in butter, and pickling onions also browned in butter. Serve the sauce, strained through a sieve, in a sauceboat.

BRAISED FILLET OF BEEF RENAISSANCE

The garnish is much the same as à la Jardinière (see p. 32), but young carrots, etc., are used, as well as the green part of fresh asparagus, and new potatoes.

BRAISED FILLET OF BEEF RICHELIEU

The garnish consists of 3 or 4 small stuffed tomatoes and the same number of stuffed mushrooms, a few braised lettuces, and a few small potatoes, cooked in butter. The strained sauce is served in a sauceboat.

BRAISED RUMP OF BEEF À LA FLAMANDE

Braise the rump of beef and garnish with the same cooked vegetables as in Boiled Beef à la Flamande (see p. 26), and strain the sauce over it.

BRAISED STEAK WITH PEAS

Remove the outer leaves of a lettuce, wash it thoroughly and drain. Put it in an earthenware casserole, with half a small onion, and over it put $1\frac{1}{2}$ pints of shelled peas, a small pat of butter, and a seasoning of salt, pepper and a little sugar. Place $1\frac{1}{2}$ to 2 lbs. of rump steak, seasoned with

salt, over the peas, cover closely, put in a moderate oven and simmer for $1\frac{1}{2}$ to 2 hours, turning the peas occasionally and basting the meat. When done, put the steak on a hot dish, carve it, put the peas around it and the lettuce divided in half.

BRAISED STEAK WITH POTATOES À LA CRÈME

Cut 2 lb. of rump steak into $\frac{1}{2}$ -inch thick slices, season with salt and brown lightly in butter, with 2 medium-sized sliced onions and 2 sliced carrots, and a bouquet of mixed herbs. When browned, add 2 ozs. of breadcrumbs, fried in butter, 2 cloves, 2 or 3 peppercorns, and barely cover with equal parts of stock and red wine. Cover with the lid, put in the oven and simmer for $1\frac{1}{2}$ hours, basting frequently. A $\frac{1}{4}$ hour before serving, remove the slices of steak from the casserole, strain the sauce, put the meat back in the casserole, and add the sauce, to which 1 gill of cream has been added, 1 tablespoon of capers and the juice of $\frac{1}{2}$ lemon. Steam the potatoes in their jackets, and when done, peel them, and put them in a saucepan with a little over a gill of cream, season with salt and pepper and simmer for 15 minutes. To serve, put the slices of steak on a hot dish, cover with the sauce, and serve the potatoes separately.

BROWN STEW

Cut $1\frac{1}{2}$ lbs. of neck of beef in pieces convenient for serving, put on a dish, and sprinkle with 2 tablespoons of vinegar. Let stand for 1 hour. Dry with a cloth and brown in a little butter. Remove the meat from the pan, and fry 1 sliced onion, 1 sliced carrot and 1 turnip till brown. Sprinkle with $1\frac{1}{2}$ ozs. of flour, stir well, then add the meat, and cover with 1 pint of stock or water. Bring to the boil, season with salt and peppercorns, and simmer

for 2½ hours. To serve, put the meat on a dish, strain the sauce over it, and garnish with cooked shredded carrots, onions, and turnips.

LES CARBONNADES FLAMANDES (Flemish Carbonades)

Cut 2½ lbs. of either boned neck of beef, top shoulder or thin flank into 2-inch lengths, about 1 inch thick, season with salt and pepper and brown in 4 ozs. of butter or lard. Add 3 ozs. of lean gammon, cut in small cubes and brown. Remove the meat and gammon from the saucepan, pour out most of the melted butter or lard, leaving about 2 tablespoons, stir in 2 tablespoons of flour, and cook gently until it begins to turn a light nutty brown colour. Add gradually 1 bottle of beer (light ale), stirring continuously. Brown 1 lb. of shredded onions in butter or lard. Put the sauce made with the beer into an earthenware casserole, and fill with alternate layers of onions and meat and gammon. Add 1 clove of chopped garlic, 2 lumps of sugar, and a seasoning of salt and pepper. Bring to the boil, cover, and simmer in the oven for 2½ to 3 hours. It may be necessary to add more beer, as the meat, etc., should be well covered with the liquid. Just before serving, add a little vinegar, and serve in a deep dish. Plain boiled potatoes are always served with the carbonade.

BRAISED BEEF SAUCE CHASSEUR

Braise from 3 to 4 lbs. of fresh brisket of beef (see p. 30), and cover with a Chasseur sauce (see p. 115).

BRAISED BEEF À LA CHIPOLATA

Any cut of braised beef can be served with this garnish : A few pickling onions, browned in butter, a few fried chipolata sausages, a few chestnuts, boiled in stock till tender, a little gammon, cut in dice and browned in butter, a few turned carrots, cooked in butter (the latter may be omitted). Serve with the strained sauce in a sauceboat.

DAUBE OF BEEF

(Beef Stew)

There is no exact English equivalent for the word "Daube," which is a beef stew, of which there are many varieties. The classical or typical *Daube* is made as follows : Divide 3½ lbs. of rump of beef into thick slices, and lard with strips of larding bacon (see p. 124) previously rolled in finely chopped parsley and a little chopped garlic. Season with salt and pepper, sprinkle with chopped shallots, put in a deep dish or casserole, add a bouquet of mixed herbs, and pour 1 bottle of red wine over the whole. Let stand for 2 hours. Then wipe the pieces of meat with a cloth, and brown in fat or butter on both sides. Place in a casserole, only just sufficiently large to hold them, over a few rashers of bacon, add the bouquet of mixed herbs, and cover with the wine in which they were marinated. Bring to the boil, cover closely, and simmer in the oven for 4 hours. Serve in the casserole, removing the bouquet of herbs.

DAUBE OF BEEF À LA PROVENÇALE

Cut 2½ lbs. of fresh silverside into 3 oz. slices, and put in a deep dish or casserole with 2 quartered onions, 2 or 3 carrots, cut in half, a bouquet of mixed herbs, salt, pepper and mixed

spices. Cover with 1 bottle of red wine, a wine-glass of vinegar, and let stand for 5 or 6 hours.

Chop 6 ozs. of fat bacon and put in an earthenware casserole. Cook over a brisk fire and, when it has melted, remove the pieces of bacon, and brown 1 quartered onion in the fat. Then add the meat, with its garnish of onion and carrot, and brown on both sides. Now add 4 or 5 cloves of garlic, a bouquet of mixed herbs, a strip of orange peel, cover the whole with the red wine and $\frac{1}{2}$ pint of hot water, cover closely, and simmer in the oven for 4 to 5 hours. Strain the sauce before serving.

COLD DAUBE À LA CRÉOLE

Put 3 lbs. of larded rump or round of beef in a saucepan, with 2 lbs. of knuckle of veal and 2 calves' feet, previously blanched, and cover with cold water. Bring to the boil and skim carefully. Add 3 onions, cut in half, 3 carrots, 2 turnips, 2 cloves of garlic, mixed herbs, salt, pepper and cayenne. Cover the saucepan with a lid, leaving an opening so that the steam may escape. Simmer for 3 to 3½ hours, till the beef is tender. Remove the beef from the saucepan and place in a large, deep basin. Simmer the other ingredients for another hour. Then remove from the saucepan and bone both knuckle of veal and calves' feet. Cut in inch lengths and add to the beef. Strain the stock into a basin through a cloth and let stand till cold. Put the whites of 2 or 3 eggs in a saucepan, with the crushed egg shells, and a glass of sherry or Madeira. Mix thoroughly with a whisk, without, however, beating to a froth. Put the cold stock in the saucepan and gradually bring to the boil, beating continuously with the whisk, so that the whites of eggs will be thoroughly mixed with the stock. When it comes to the boil, stop beating and simmer gently for 15 to 20 minutes.

Strain through a jelly bag or cloth. The stock should be perfectly clear. Pour the clarified stock over the meat, and stand in a cool place or on ice till set in a firm jelly. The *daube* can be garnished with the carrots, cut in fancy shapes and added when the stock just begins to set. Turn out carefully, and garnish with sprigs of parsley and a few chilli peppers.

ESTOUFFADE OF BEEF

Divide 1½ lbs. of top shoulder of beef and the same quantity of top ribs, in square slices, weighing each 2½ to 3 ozs. and lard them (see p. 124). Brown the meat and 3 onions, cut into quarters, in the fat in which ½ lb. of lean bacon, cut in dice, has been cooked. Add 2 tablespoons of flour, stir well and cook till browned. Then add 1 bottle of red wine, ¾ pint of beef stock, a bouquet of mixed herbs, season with salt and peppercorns, cover closely, and simmer for 2½ to 3 hours in the oven. Pour the contents of the saucepan on a wire sieve, over a basin. Remove the pieces of meat and the dice of bacon, and put in a deep frying pan, with quartered mushrooms, previously cooked in butter. Let the sauce stand for 15 minutes, so that it can be skimmed. If too thin, thicken it by reducing, and if too thick, add a little stock. Strain over the meat, etc., and simmer for another 15 minutes and serve.

EXETER STEW

Remove all fat and gristle from 2 lbs. of lean beef, and cut the meat in 8 or 10 pieces. Put them in a stewing jar with 2 tablespoons of vinegar, and put in a cool oven. Fry 2 or 3 sliced onions in butter, sprinkle with 1½ ozs. of flour, cook till brown and add 1½ pints of water, bring to the boil

and pour over the meat in the jar. Season with salt and pepper, cover closely and cook in a moderate oven for 3 hours. Make some savoury balls with 4 ozs. of flour, 1½ ozs. of chopped suet, 1 tablespoon of chopped parsley, ½ teaspoon of powdered mixed herbs, 1 teaspoon of salt, ½ teaspoon of baking powder, and 1 saltspoon of pepper. Work all the ingredients in a basin and shape into small balls. Bring the stew to the boil and add the balls to it 40 minutes before required. To serve, pile the meat in the middle of the hot dish, strain the sauce over it, and garnish with the savoury balls.

GULLASH (Austrian and Hungarian) (Beef Stew)

Melt 2 or 3 ozs. of butter or fat in a saucepan and add 5 or 6 thinly sliced onions. Cook till they begin to brown. Then add 1½ lbs. of beef, cut in 1-inch cubes, 1 or 2 cloves of chopped garlic, 1 tablespoon of paprika, a few caraway seeds, and season with salt and pepper. Cook till the meat is slightly brown, then add sufficient hot stock or water to cover the meat and simmer for 1½ to 2 hours. Serve in the casserole in which it was cooked. Dumplings of some kind are served with Gullash, or macaroni or nouilles.

HOT POT

Cut 2 lbs. of lean beef into 8 or 10 pieces. Slice ½ lb. of onions, and quarter 2 or 3 lbs. of potatoes. Place a layer of potatoes in an earthenware dish, over this place a layer of meat and sliced onions, and continue thus till the dish is filled. Season with salt and pepper, fill the dish 3 parts full of water, cover with a greased paper and put in a moderate oven for 2 hours. Serve in the same dish.

STEWED LEG OF BEEF

Cut 1 lb. of leg of beef in 5 or 6 pieces, put in a dish and pour 2 tablespoons of vinegar over them. Let stand for 1 hour, turning occasionally. Then put them in a jar, with the vinegar, season with salt and pepper, add 1 thickly sliced onion, carrot and small turnip, mixed herbs, and $\frac{3}{4}$ pint of water. Cover closely, and either cook in a very slow oven for 3 hours, or stand in a saucepan of boiling water. Serve the stew on a hot dish with its strained sauce.

BEEF À LA MODE

Lard $3\frac{1}{2}$ to 4 lbs. of rump of beef with strips of larding bacon (see p. 124 for larding), previously marinated in a little brandy, salt, pepper, mixed spices, and sprinkled with finely chopped parsley. Rub the meat over with salt and pepper, put in a deep dish with $\frac{1}{2}$ bottle of red wine and a little brandy, and let stand for 5 to 6 hours. Braise in the same manner as Fillet of Beef (2) (p. 32), using the wine of the marinade and adding 2 calves' feet, previously blanched, boned and tied up with string. When three-quarters cooked, put the meat in another and smaller saucepan, with the calves' feet, cut in small squares, $\frac{3}{4}$ lb. of pickling onions, browned in butter, the same of turned carrots, previously boiled, but not soft, cover with the strained sauce and simmer for another 20 minutes. Garnish with the carrots and onions and cover with the sauce.

BEEF À LA MODE À LA MÉNAGÈRE

Brown the larded beef equally on all sides in a little butter or fat. Drain off all the fat, add 6 tablespoons of red wine, 1 of brandy, and reduce to 2 tablespoons. Then add

1 calves' foot, prepared as in the preceding recipe, a slice of larding bacon, 1 quartered onion, a bouquet of herbs, and sufficient stock or water to not quite cover the meat. Bring to the boil, cover closely, and simmer in the oven for 4 hours, turning the meat occasionally. One hour before serving, add $\frac{1}{2}$ lb. of thickly sliced carrots. Put the meat on a hot dish, garnish with the vegetables and calves' foot, cut in small squares, strain $\frac{1}{2}$ pint of the sauce, and pour over the meat.

COLD BEEF À LA MODE

Proceed as in the foregoing recipe. When done, put the meat in an earthenware terrine or large salad basin, over half of the vegetables, surround with the pieces of calves' foot, cut in small squares, and the rest of the vegetables, and cover with the strained sauce, adding a little Madeira. Stand in a cold place till set in a jelly.

BEEF À LA MODE WITH NOUILLES

This consists of Beef à la Mode à la Ménagère (see p. 40) served with nouilles mixed with butter and freely sprinkled with grated Parmesan cheese.

PAUPIETTES OF BEEF WITH DUXELLES SAUCE

A Paupiette is a thin slice of meat covered with a thin layer of stuffing and rolled up and tied.

Put a layer of finely chopped mushrooms, mixed with a little Duxelles sauce (see p. 116) on each slice of meat, roll and tie up. Braise (see p. 30), and serve with Duxelles sauce.

PAUPIETTES OF BEEF WITH ANCHOVIES AND OLIVES

Put a layer of finely chopped anchovies (in oil) and olives on each slice of meat, roll and tie up and braise (see p. 30). Strain the sauce and pour over the paupiettes.

BEEF ROLLS OR OLIVES

The meat is cut in the same manner as for Paupiettes, spread with a layer of veal forcemeat (see p. 121), rolled and tied, and braised. Serve on a bed of mashed potatoes and strain the sauce over them.

BEEF, GRILLED

GRILLED BEEFSTEAK

For grilling meat, see p. 18. Grilled beefsteak can be served with a garnish of watercress, scraped horseradish, with grilled or baked tomatoes, with fried onions, or with Oyster sauce (see p. 118). Grilled meat should be served as soon as done, and should never be put in the oven to keep warm.

BEEFSTEAK AND FRIED POTATOES

Grill the steak, place a few pats of Maître d'Hôtel butter (see p. 123) on it, and garnish the dish with round potato chips.

BEEFSTEAK À LA MIRABEAU

Grill the steak, and cover with a trellis work of boned

filleted anchovies in oil, stoned olives and a few tarragon leaves. Serve with Anchovy butter (see p. 122).

BEEFSTEAK VERT PRÉ

Grill the steak, put on a hot dish, and at each end of the dish put a garnish of watercress and straw potatoes.

CHAUTEAUBRIAND

The cut known as Chateaubriand is a steak cut from the middle of the fillet of beef, about 2 inches thick. It should not weigh more than 1 to 1½ lbs. It is grilled and the classical and traditional way of serving it is with Maître d'Hôtel butter (see p. 123) or a Colbert sauce (see p. 115), and with a garnish of potatoes cut to the shape of large olives, seasoned with salt and pepper and simmered in butter for 25 to 30 minutes till lightly browned.

ENTRECÔTE À LA BÉARNAISE

The entrecôte is a steak cut from the sirloin. Grill and serve with a Béarnaise sauce (see p. 113) in a sauceboat, and garnish the dish with potatoes cooked as in the previous recipe.

ENTRECÔTE GRILLÉE SAUCE PIQUANTE

Grill the entrecôte and cover with Piquante sauce (see p. 119).

ENTRECÔTE AUX HUITRES

(Entrecôte with oysters)

Grill the entrecôte and serve with a sauce made as follows : Chop $\frac{1}{2}$ lb. of shallots very finely and put in a saucepan with $1\frac{1}{2}$ pints of vinegar. Bring to the boil and simmer till the vinegar has almost completely evaporated. Serve, on a separate plate, the cold oysters in their half shells. The contrast of a mouthful of hot steak with the hot sauce, eaten alternately with the cold oysters, is most pleasing to the palate.

ENTRECÔTE À LA MARSEILLAISE

Grill the entrecôte, and serve with Maître d'Hôtel butter mixed with a quarter of the quantity of Tomato butter (see p. 123) and $\frac{1}{2}$ a clove of crushed garlic. Garnish with "Ribbon" potatoes and small tomatoes, emptied and baked for 10 minutes in the oven with oil and a little garlic, and then filled with a stoned olive, surrounded with a fillet of anchovy. To make "Ribbon" potatoes, pare the potato as if it were an apple. Fry the parings in deep fat, drain and sprinkle with salt. They should be quite dry and crisp.

ENTRECÔTE MEXICAINE

Grill the entrecôte and garnish with grilled mushrooms, covered with thick tomato pulp, and grilled pimentios. Serve with a highly seasoned Tomato sauce (see p. 120).

PORTERHOUSE STEAK

Porterhouse steak is a sirloin of beef cut as a steak, to a

thickness of $1\frac{1}{2}$ to 2 inches. Grill and serve with fried onions and chip potatoes (round).

GRILLED RUMPSTEAK

Grill the rumpsteak and serve with grated horseradish.

RUMPSTEAK MIRABEAU

Grill the rumpsteak and garnish with anchovies, stoned olives, and a few tarragon leaves. Serve with Anchovy butter (see p. 122).

BEEF, ROASTED

PLAIN ENGLISH ROAST BEEF

For method of roasting meat, see p. 17. The pieces which are usually roasted are the sirloin, the fillet, the ribs, the round and the aitchbone. In England, the usual accompaniments to roast beef are Gravy, Horseradish sauce (see p. 117) and Yorkshire pudding which is made as follows: Put 4 tablespoons of flour in a basin with a good pinch of salt, mix with 1 gill of milk, add 2 whole eggs, and beat thoroughly, adding just over another gill of milk, cover and let stand for at least 1 hour. Put a little fat in a shallow baking tin and put this in the oven to get thoroughly hot. Beat up the batter once more, add 1 tablespoon of cold water, pour into the hot fat and put in a brisk oven for 15 to 20 minutes.

ROAST SIRLOIN WITH POTATOES CHÂTEAU

This consists of roast beef, with a garnish of potatoes cut to the shape of large olives and seasoned with salt and

pepper and simmered in butter for 25 or 30 minutes till lightly browned, and the gravy which has come from the meat (see Gravy, p. 117).

ROAST SIRLOIN WITH ROBERT SAUCE

Add a few thin strips of cooked tongue to a Robert sauce (see p. 119) and serve with the roast beef.

ROAST SIRLOIN WITH POTATO CROQUETTES

Garnish the dish with potato croquettes, and serve with a Bordelaise sauce (see p. 114).

ROAST FILLET OF BEEF

Lard the fillet (see p. 124) and roast it, basting frequently. Serve plain, with the gravy from the pan (see Gravy, directions for roasting, p. 117).

FILLET OF BEEF DAUPHINE

Roast the larded fillet, basting frequently with butter. Put on a hot dish and garnish with potato croquettes, and serve with Madeira sauce (see p. 117).

FILLET OF BEEF À LA HONGROISE

Roast the larded fillet and garnish with clusters of cauliflower, covered with Mornay sauce (see p. 118), to which a little paprika and chopped ham have been added, and with a

few medium-sized onions, boiled and lightly browned in butter. Serve with a thin Soubise sauce (see p. 120), seasoned with paprika.

FILLET OF BEEF À LA JARDINIÈRE

Roast the fillet and garnish in the same manner as Braised Fillet Jardinière (see p. 32).

FILLET OF BEEF WITH MUSHROOMS

Roast the fillet, basting with butter, and garnish with mushrooms, previously cooked in butter and serve with a Madeira sauce (see p. 117).

FILLET OF BEEF RICHELIEU

Roast the fillet and garnish in the same manner as Braised Fillet Richelieu (see p. 33).

FILLET OF BEEF (Cold)

Fillet of beef which is to be eaten cold, should be larded and roasted. When quite cold it should be coated with aspic jelly and garnished with the same jelly, cut in different shapes or merely coarsely chopped.

HUNTER'S BEEF

This consists of a round of pickled beef (see p. 26). Put the beef in a meat tin with $\frac{1}{2}$ pint of water, cover the top of

the meat with minced suet, and over the whole put a crust of flour and water. Bake or roast for 6 hours. When cold, remove the paste and glaze or coat with aspic jelly.

BEEF, SAUTÉ AND FRIED (in Butter or Oil)

The pieces of beef most suitable to this manner of cooking are the entrecôte, or sirloin steak, the small filets, or *filets mignons*, the tournedos and medallions. In all cases they should be well seasoned with salt and pepper before being cooked.

ENTRECÔTE OR SIRLOIN-STEAK À LA BORDELAISE

The entrecôte is sautéed in butter put on a hot dish, and garnished with cooked beef marrow. Serve with Bordelaise sauce (see p. 114).

ENTRECÔTE AUX CHAMPIGNONS (Sirloin Steak with Mushrooms)

The entrecôte is sautéed, put on a hot dish and garnished with mushrooms, also cooked in butter. Serve with Espagnole sauce (see p. 116).

ENTRECÔTE À LA HONGROISE

The entrecôte is sautéed in butter, with $\frac{1}{2}$ lb. of gammon cut in dice and previously blanched. Add 2 chopped onions, and cook till brown. Sprinkle with 1 tablespoon of paprika, mix in 4 tablespoons of white wine and cook till reduced to two-thirds. Add $\frac{1}{2}$ pint of Velouté sauce (see

p. 121) and cook for another 8 minutes. Put the entrecôte on a hot dish, surround with plain boiled potatoes and cover with the sauce.

ENTRECÔTE À LA TOMATE

The entrecôte is sautéed and surrounded with a thick Tomato sauce (see p. 120).

SUNDRIES

BEEFSTEAK AND KIDNEY PIE

Ingredients : 1 lb. of lean beef, veal or lamb kidneys, 1 tablespoon of chopped onion, a pinch of chopped parsley, stock or water, butter, salt and pepper. Puff pastry or short crust.

Method : Cut the meat into slices about $\frac{1}{2}$ inch thick, and slice the kidneys. Brown both lightly in butter. Arrange them in a pie-dish, sprinkle with the chopped onion, previously lightly browned in butter, the parsley, season with salt and pepper and add sufficient stock or water to just cover the meat. Cover with a lid of either puff pastry or short crust, press the edges down firmly, moistening the paste slightly, decorate with pastry cut in fancy shapes, make a slight opening in the centre of the pie, to allow the steam to escape, brush over with beaten yolk of egg and bake in a slow oven for about $2\frac{1}{2}$ hours. Pour a little hot stock in the pie a few minutes before serving.

BEEFSTEAK AND KIDNEY PUDDING

Line a pudding basin with suet paste and fill with slices of lean beef and sliced kidneys, seasoning with salt and

pepper. Cover with weak stock or water, make a lid with more suet paste, moisten the edges and press down firmly, so that the pudding is well sealed. Tie in a scalded and floured pudding cloth and boil for 3 to 3½ hours or steam for 4 hours.

BEEFSTEAK AND OYSTER PIE

Proceed as in recipe for Beefsteak and Kidney Pie (see p. 49), but omitting the kidney, and adding 1 to 1½ dozen oysters.

BEEFSTEAK PIE

Proceed as in recipe for Beefsteak and Kidney Pie, but instead of the kidney add ¾ lb. of potatoes, sliced ½ inch thick.

BEEFSTEAK PUDDING

Proceed as in recipe for Beefsteak and Kidney Pudding, but omitting the kidneys, and using sliced potatoes instead, arranging them in alternate layers with the meat.

BŒUF STROGONOFF (Russian)

Cut 1 lb. of lean beef, preferably fillet, into 1-inch squares, sprinkle with salt and pepper and let stand for 2 hours. Brown 1 oz. of flour in 1 oz. of butter, and add 1 pint of hot stock gradually, stirring continuously. Stir in 1 tablespoon of tomato juice and 2 of sour cream. Brown the meat in butter on a quick fire, with a little chopped onion. When brown, put the meat in the sauce and simmer for 15 minutes. Then bring to the boil and serve at once.

BEEF, CURRIED

Lightly brown 2 chopped onions in butter, add $\frac{1}{2}$ lb. of sliced and quartered tomatoes and cook for about 10 minutes, crushing the tomatoes with a wooden spoon to extract the juice. Season with salt, pepper, cayenne and mix in 1 level tablespoon of curry powder, or more, according to taste. Cut 1 lb. of round of beef into slices about 4 inches square, add to the tomatoes and onions, dilute the sauce with a little hot stock or water, as it should not be too thick, cover the pan with a dish and simmer for 30 minutes or till the meat is tender. Add a little more liquid if necessary, and turn the meat occasionally. To serve, put the meat on a hot dish and pour the sauce over it. Mango chutney and plain boiled rice is usually eaten with this.

ESTERHAZY STEAKS (Hungarian)

Grill a few small steaks, taken from the loin, and when nearly done, add them to 1 or 2 sliced onions, carrots and turnips, browned in butter. Add 1 gill of sour cream and sprinkle with 1 tablespoon of paprika. Simmer for about 15 minutes, till the steaks are tender. They should be slightly underdone.

GALANTINE OF BEEF

Put 2 lbs. of lean beef in a saucepan, with 1 lb. of fat pork and 1 lb. of gammon. Cover with warm water, bring to the boil and simmer till tender. Remove from the saucepan, and when cold, mince the three together, add 2 finely chopped onions, a clove of garlic, a little parsley, thyme, marjoram, 1 bayleaf, season lightly with salt and pepper,

and bind with the yolks of 3 or 4 eggs. Moisten with a little stock, shape into a large sausage, tie in a cloth and steam for 1 hour. Remove from the cloth only when quite cold.

PLANKED SIRLOIN STEAK WITH OYSTERS (American)

Grill the steak for 5 minutes on each side. Meanwhile make the plank (an oak board about an inch thick and slightly larger than the meat) very hot by putting it in the oven. Butter the board, put the steak on it, garnish with mashed potatoes and put under the grill, turning the steak once. Grill for another 10 minutes, then season with salt and pepper, brush over with melted butter, place a few grilled oysters over the steak, and serve very hot.

Veal

BRAISED AND STEWED

BLANQUETTE OF VEAL

Ingredients (for 6 to 8 people): 2½ lbs. of veal tendrons or leg or ribs, 1 large onion stuck with 1 clove, 2 ozs. of chopped carrots, mixed herbs, a small piece of celery, a little less than 1 tablespoon of salt.

For the sauce: 1½ ozs. of butter, 1 oz. of flour, ¾ pint of veal stock, mushroom peelings, the yolks of 2 eggs, 6 tablespoons of cream, the juice of 1 lemon, 1 teaspoon of chopped parsley.

To garnish: 8 mushrooms of the same size, about 12 pickling onions, 1 oz. of butter.

Method: Cut the veal in 2-inch lengths and put in a saucepan with sufficient cold water to cover. Bring to the boil gradually and skim very carefully. When the scum has ceased to rise, add the sliced vegetables and the herbs. Season with salt. Bring to the boil, put the lid on the saucepan, leaving a small opening, and simmer gently for 1 hour or a little more till the meat is tender but still firm. Meanwhile boil the mushrooms in a little water and cook the pickling onions in butter, but without browning. Make the sauce by putting the butter in a saucepan, and when melted add the flour and work to a smooth paste. Then dilute gradually with the strained veal stock, stirring well. Bring to the boil, add the mushroom peelings and a few peppercorns. Skim carefully and add the egg *liaison*—made by mixing the eggs in a basin with the lemon juice, a few tablespoons of cold stock, and adding gradually a few tablespoons of the warm sauce. Add the cream and stir. Now put the pieces of veal in a clean saucepan, pour the strained sauce over them, add the mushrooms and cook for a few minutes without boiling. Just before serving add the onions. To serve, put the pieces of veal in the centre of a hot dish, pour the sauce over them and garnish with the mushrooms and onions. Sprinkle with chopped parsley.

BLANQUETTE OF VEAL WITH CELERY

Proceed exactly as in the foregoing recipe, but omitting the garnish of mushrooms and onions. Blanch the celery in boiling salted water, drain, cut in 3-inch lengths, and add to the blanquette $\frac{3}{4}$ hour before serving.

BLANQUETTE OF VEAL WITH CUCUMBER

Proceed as in foregoing recipe, but adding peeled and blanched cucumber cut in 3-inch lengths to the blanquette 30 minutes before serving.

BLANQUETTE OF VEAL WITH CHICORY

Proceed as in foregoing recipe, but blanch the chicory for 20 minutes in boiling salted water, drain thoroughly, divide each head of chicory in half and add to the blanquette $\frac{3}{4}$ hour before serving.

BLANQUETTE OF VEAL WITH NOUILLES OR SPAGHETTI

Make the blanquette as in the first recipe with the onions and mushroom garnish. The nouilles or spaghetti should be blanched in boiling salted water for 3 to 4 minutes, thoroughly drained, and added to the blanquette 10 minutes before serving. Or it may be boiled in water for a few minutes longer, well drained, mixed with a little butter and served separately.

BRAISED LOIN OF VEAL

Braise as indicated on p. 22 (Methods of Cooking), thicken the strained sauce with 1 oz. of flour mixed with 1 oz. of butter, add 1 teaspoon of lemon juice and 1 tablespoon of capers and pour over the meat.

BRAISED LOIN OF VEAL À L'ALSACIENNE

Braise the veal as indicated on p. 22 (Methods of Cooking)

and serve with the strained sauce poured over it, and garnish with braised sauerkraut and small slices of cooked ham.

BRAISED LOIN OF VEAL À LA BERRICHONNE

Braise the veal, strain the sauce and thicken with a little arrowroot or flour. Put on a hot dish and garnish with braised cabbage shaped into small balls, a few small slices of lean bacon, which was cooked with the cabbage, 20 pickling onions and 20 large chestnuts, both of which have been cooked with the veal.

BRAISED LOIN OF VEAL À LA FLAMANDE

Braise the veal, strain the sauce over it and garnish with braised cabbage shaped into small balls, 5 or 6 carrots and turnips, cut small and boiled, a few strips of bacon which have been cooked with the cabbage, and a few sliced sausages.

BRAISED LOIN OF VEAL À LA NIVERNAISE

The braised veal is garnished with 1 lb. of carrots, turned to the size and shape of olives, and $\frac{1}{2}$ lb. of pickling onions, both previously boiled and lightly browned in butter. Strain the sauce over the whole.

BRAISED LOIN OF VEAL WITH SORREL

The purée of sorrel (see p. 123) can either be served on the dish with the meat, the sauce being strained over the veal, or it can be served separately. A purée of spinach or of endive can also be served with braised veal.

BRAISED STUFFED LOIN OF VEAL

Bone the veal, fill with veal forcemeat (see p. 121) and braise. Garnish with rolled bacon, fried crisp, and quartered lemons and strain the sauce over the meat.

BRAISED NECK OF VEAL WITH CELERY

Braise the veal, put on a hot dish with a piece of boiled bacon and garnish the dish with braised celery. Strain the sauce over the whole.

STEWED BREAST OF VEAL

Remove the bones and flatten the meat with a beater or rolling pin. Season with salt and pepper, spread a thin layer of veal forcemeat (see p. 121) over it, roll up and tie up firmly with string or tape. Stew as directed on p. 22 (Methods of Cookery). When done, put on a hot dish, strain a little of the sauce over it, and garnish with small veal forcemeat balls fried in butter, rolls of fried bacon and quartered lemons. Serve Gravy (see p. 117) separately in a sauceboat.

STEWED BREAST OF VEAL WITH PEAS

Divide the meat into neat slices and stew in the same manner as in the foregoing recipe. Forty-five minutes before serving add 1 pint of shelled peas to the stew. To serve, put the meat in the centre of the dish over the peas, garnish with veal forcemeat balls, rolls of fried bacon and quartered lemon. Strain the sauce into a small saucepan and stir in 2 tablespoons of mushroom ketchup, 2 table-

spoons of Tomato sauce (see p. 120) and 1 tablespoon of lemon juice. Bring to the boil and pour over the meat.

STUFFED BREAST OF VEAL À LA PROVENÇALE

Stuff the boned breast of veal with the following stuffing : Fry 2 chopped onions in fat to a golden colour, add $\frac{1}{2}$ lb. of chopped gammon, $\frac{1}{2}$ lb. of bread, soaked in milk and well squeezed, mix all thoroughly, season with salt and pepper, and cook for a few minutes. Then add 2 whole eggs and 3 yolks, 1 clove of chopped garlic, and a little chopped parsley. Braise the stuffed breast (see p. 22 for Braising, Methods of Cooking) and serve with the strained sauce poured over it.

BREAST OF VEAL STEWED WITH RED WINE

Divide the breast of veal in slices and brown in fat or oil with $\frac{1}{2}$ lb. of lean gammon, cut in dice, and 1 clove of garlic. When well browned add 1 teaspoon of flour, mix well and moisten with 1 gill of stock and just over 1 gill of red wine. Season with salt and pepper, add a bouquet of mixed herbs, and simmer gently for 3 hours. Ten minutes before serving add a few chopped mushrooms and small chopped onions, previously browned in butter.

CHOPS

Veal chops can be either grilled, sauté in butter or coated with breadcrumbs and cooked in butter or oil. All the methods of cooking or garnishing veal cutlets are applicable to the chops.

CÔTE DE VEAU EN BELLE-VUE

Braise a loin of veal and, when cold, trim carefully and decorate with various cooked vegetables, cut in fancy shapes. Line a mould in which the loin will fit with aspic jelly, place the loin in it, with the decorated side downwards, and cover with more jelly. Put in a cold place or on the ice till quite firm. To take out of the mould, dip a small knife in hot water and detach the sides of the jelly from the mould. Wrap a towel dipped in very hot water around the mould and carefully turn out the loin on a dish. Garnish with chopped aspic jelly.

CÔTE DE VEAU EN COCOTTE

Season the loin with salt and pepper and brown in butter in an earthenware casserole or cocotte. Add a few tablespoons of stock and simmer till quite tender. Half an hour before serving add 6 pickling onions, browned in butter, 3 or 4 potatoes turned to the size of olives, and 2 or 3 quartered uncooked mushrooms. Add a little more stock just before serving.

CURRY OF VEAL

Cut $\frac{3}{4}$ lb. of lean veal in 1-inch lengths. Slice 2 or 3 onions and fry to a golden brown in butter with 2 cloves of chopped garlic. Stir in $\frac{1}{2}$ tablespoon of curry powder, season with salt and add 1 quartered tomato, 1 or 2 tablespoons of warm water and mix well, crushing the tomato with a wooden spoon to extract the juice. Put in the pieces of meat and cook till well browned. Then cover with $\frac{1}{2}$ pint of hot water and simmer gently for about 1 to $1\frac{1}{2}$ hours, adding more hot water if the sauce is too thick. Half an

hour before serving add 3 or 4 tomatoes, peeled and finely chopped. Serve with plain boiled rice.

CÔTELETTE DE VEAU À L'ÉTOUFFÉE

Melt 2 ozs. of butter in an earthenware casserole and, when hot, put in the veal cutlets, cover these with a thin layer of chopped gammon, previously blanched, chopped onion, garlic and parsley. Brown thoroughly, moisten with a little hot water and $\frac{1}{2}$ tumbler of red wine, cover the casserole and simmer gently for $1\frac{1}{2}$ hours. Just before serving add a lump of butter to the sauce.

CÔTELETTES DE VEAU À LA LYONNAISE

Lard the veal cutlets with thin strips of larding bacon (see p. 124), with strips of anchovy and strips of gherkins. Season with salt and pepper, put in a deep dish, and pour a little oil over each, and sprinkle with chopped parsley, chives and shallots. Let them stand for 1 hour. Tie a piece of larding bacon around each, put them in a saucepan with the marinade, and simmer gently till they are cooked. Remove the larding bacon and pour the following sauce over them: Put 1 teaspoon each of chopped parsley, chives and shallots in a small saucepan with 1 heaped tablespoon of butter, 2 tablespoons of stock, 1 tablespoon of oil, and stir in 1 teaspoon of flour. Stir till hot and well mixed, season with salt and pepper, remove from the fire and add the juice of 1 lemon.

FILLET OF VEAL, STEWED

Flatten the fillet with a beater or rolling pin and spread with a layer of veal forcemeat (see p. 121). Roll and tie

securely with string or tape. Stew or braise (see p. 22, Methods of Cooking), thicken the strained sauce with a little flour and butter and the juice of 1 lemon, and pour over the meat.

FILLET OF VEAL BRAISED WITH VEGETABLES

Braise the fillet of beef, which should be wrapped in larding bacon. Put on a hot dish, strain the sauce over it, and garnish with cooked carrots, small onions and small turnips, previously boiled and lightly browned in butter.

FILLET OF VEAL ORLOFF

Wrap the fillet in thin strips of larding bacon and braise. When done, carve into neat slices, and between each slice put a layer of Soubise sauce (see p. 120), replace the slices so that the fillet looks whole, cover with a thin layer of Soubise sauce and finally with a layer of Mornay sauce (see p. 118) and put in a quick oven for 5 to 8 minutes.

FRICANDEAU OF VEAL

Lard a piece of veal taken from the leg, and not more than 1½ inches thick, and braise it till sufficiently tender to be cut with a spoon. Put on a hot dish and strain the sauce over it.

FRICASSÉE OF VEAL

This is done in exactly the same manner as the blanquette of veal, but the mushrooms and pickling onions are cooked in the strained sauce instead of being cooked separately (see Blanquette of Veal, p. 52).

GRENADINS OF VEAL

The grenadin of veal is similar to an escalope of veal, but is kept thicker and is always larded (see p. 124). The slice should be from 3 to 3½ inches long and 1 inch thick. It is always braised and served with the strained sauce, and a garnish of either mushrooms, purée of spinach, purée of sorrel, peas, asparagus tips, etc.

GRENADINS EN BELLE-VUE

See Côtes de Veau en Belle-Vue, p. 58.

KNUCKLE OF VEAL, STEWED

Separate the shank bone and braise or stew (see p. 22, Methods of Cookery) with the meat. To serve, put the veal on a hot dish with a piece of boiled bacon, cooked separately, strain a little sauce over it, and serve with Béchamel sauce (see p. 114) to which chopped parsley and a little lemon juice have been added and simmered for a few minutes.

KNUCKLE OF VEAL À LA BOURGEOISE

Braise the knuckle of veal, strain the sauce over it and garnish with turned carrots and onions, boiled and then browned in butter, and strips of gammon, also lightly browned in butter.

NOIX DE VEAU BRAISÉE

Take a piece of the topside and lard it closely. Braise and strain a little of the sauce over it. Serve with a Tomato sauce (see p. 120) and either with braised endive, with a purée of sorrel, a purée of mushrooms.

OSSO BUCO (Italian) (Veal Stew)

Saw 2 or 3 lbs. of knuckle of veal into 2-inch lengths—do not chop it as the marrow should remain inside the bone. Chop 3 or 4 carrots, 1 or 2 sticks of celery, and put them in a saucepan with a good lump of butter. Add the meat and season highly with salt and pepper. When the vegetables and meat are well browned, add a little butter worked with 1 tablespoon of flour. Stir and cook till the flour begins to brown. Then add $\frac{1}{2}$ pint of tomato pulp (see p. 124), 1 glass of white wine, and sufficient stock or water barely to cover the meat. Add a sprig of thyme, parsley, 1 bayleaf, and season with salt and pepper. Simmer for 1 to $1\frac{1}{2}$ hours. Ten minutes before serving remove the meat from the saucepan and strain the sauce, removing the herbs. Then replace both meat and sauce in a clean saucepan and just before serving sprinkle with a strip of finely chopped lemon peel and a little chopped parsley.

SAUTÉ OF VEAL WITH AUBERGINES

Cut $1\frac{1}{2}$ lbs. of veal tendrons (see p. 66) in pieces weighing not more than 2 ozs. and brown in a little butter and oil. Strain off a little of the fat and add 1 large onion, finely chopped, and 1 clove of garlic, crushed with the blade of a knife. Brown lightly and add 6 tablespoons of white wine. Reduce to about 1 tablespoon. Then add 1 pint of stock, $\frac{1}{2}$ pint of Tomato sauce (see p. 120), mixed herbs, cover and simmer in the oven for $1\frac{1}{2}$ hours. Remove the meat from the saucepan or casserole and put in a clean saucepan. Strain the sauce and boil till reduced by half and pour over the meat. To serve, put the meat on a hot dish with the sauce and garnish with rounds of fried aubergines.

SAUTÉ DE VEAU CHASSEUR

Proceed as in the previous recipe for Sauté of Veal with Aubergines, but reduce the sauce still further and add to it 1 gill of Chasseur sauce (see p. 115). Pour over the meat and simmer for 15 minutes. Serve and sprinkle with a little chopped and blanched parsley.

SAUTÉ DE VEAU AUX CHAMPIGNONS

Brown the pieces of veal lightly in butter and oil and drain off the fat. Cover with 1 pint of good stock and $\frac{1}{2}$ pint of Espagnole sauce (see p. 116), a bouquet of mixed herbs and simmer for 1 $\frac{1}{2}$ hours. Remove the meat from the saucepan and put in a clean saucepan. Strain the sauce and add to it 6 tablespoons of the water in which the mushrooms were boiled. Reduce to one-third and pour over the meat. Add a few mushrooms, previously boiled, then tossed in butter, and simmer for 15 minutes.

SAUTÉ DE VEAU À L'INDIENNE

Brown the meat in oil with 1 large chopped onion and $\frac{1}{2}$ tablespoon of curry powder. When well browned drain off the oil and sprinkle with 1 oz. of flour, stir for a few minutes and cover with veal stock. Season with salt, add a bouquet of herbs, bring to the boil and simmer for 1 $\frac{1}{2}$ hours. To serve, put the pieces of veal on a hot dish and strain the sauce over them. Serve with plain boiled rice.

SAUTÉ DE VEAU MARENGO

Proceed as in recipe for Sauté of Veal with Aubergines (p. 62), and simmer for 1 $\frac{1}{2}$ hours. Remove the meat from

the saucepan and replace in another saucepan with a few pickling onions, browned in butter, a few cooked mushrooms, and a little chopped parsley. Reduce the strained sauce by one-third, pour it over the meat and vegetables and simmer for another 15 minutes. Garnish the dish with croûtons of fried bread.

SAUTÉ OF VEAL WITH NOUILLES

Proceed as in recipe for Sauté de Veau aux Champignons, p. 63, but, instead of mushrooms, add nouilles or spaghetti, previously blanched in boiling salted water and cook till tender.

SAUTÉ DE VEAU À LA PORTUGAISE

Proceed as for Veau Sauté Marengo, p. 63, but, instead of adding onions and mushrooms, add 1 lb. of chopped tomatoes and a little chopped parsley and simmer for 15 minutes.

STEWED SHOULDER OF VEAL

Bone the veal, and flatten it, and stuff with 12 ozs. of sausage meat and 6 ozs. of veal forcemeat (see p. 121), putting them in alternate layers. Roll up and tie with tape, and stew it (see Methods of Cooking, p. 22). To serve, put the meat on a hot dish, strain a little of the sauce over it and garnish with rolls of fried bacon, slices of cooked tomatoes and quartered lemons. Serve the remaining sauce in a sauceboat.

STUFATINO (Italian) (Veal Stew)

Cut 1½ to 2 lbs. of leg of veal into 2-inch lengths or in

small slices. Put 4 tablespoons of oil in a saucepan or in an earthenware casserole, and when hot add 2 or 3 cloves of chopped garlic. Cook till lightly browned and add the meat, seasoning with salt and pepper. When the meat is browned, add $\frac{1}{2}$ pint of tomato pulp (see p. 124), 6 tablespoons of white wine and 2 sprigs of rosemary. Bring to the boil, cover and simmer for $1\frac{1}{2}$ hours till the meat is very tender.

STUFFED SHOULDER OF VEAL

Bone the shoulder of veal, season with salt and pepper and stuff with the following mixture: One-third each of chopped beef or veal kidney, suet and bread soaked in milk and well squeezed, 2 eggs and mixed herbs, all well seasoned with salt and pepper. Roll up, tie with tape and braise (see p. 22, Method of Cooking). Serve with a piece of boiled bacon and strain a little of the sauce over the whole.

STUFFED SHOULDER OF VEAL À LA FRANÇAISE

Fill the boned shoulder with sausage meat mixed with chopped mushrooms and 2 eggs, and braise. Serve with some kind of vegetable purée or with nouilles or spaghetti, and serve the strained sauce in a sauceboat.

STUFFED SHOULDER OF VEAL À LA BOULANGÈRE

Stuff the shoulder in the same manner as in the foregoing recipe, and roast till three-quarters done. Then put it in an earthenware dish with the bastings, surround with sliced onions lightly browned in butter, and with sliced potatoes. Season with salt and pepper and finish cooking in the oven.

TENDRONS OF VEAL, BRAISED

The tendrons are found at the extremity of the ribs. Previous to detaching them, remove the dry bone which is next to them. Then sever from the bone and cut into scollops. With a sharp knife remove the membrane which covers one side of the tendrons and divide the meat into $2\frac{1}{2}$ to 3-inch squares. Brown them in butter and braise (see p. 22, *Methods of Cookery*). Strain a little of the sauce over them.

FRIED TENDRONS OF VEAL

Prepare and cook as in the foregoing recipe. Remove from the saucepan and put on a dish, put another dish over them with a light weight on it. When quite cold, coat with flour, egg and breadcrumbs and fry to a light golden colour in hot oil. Serve with either Tomato or Espagnole sauce (see p. 166).

CURRIED TENDRON OF VEAL

Prepare and partially braise the tendrons, as in the foregoing recipe, and finish cooking as in *Curry of Veal*, on p. 58.

TENDRONS OF VEAL MARENGO

Prepare the tendrons as in the preceding recipes and cook in the same manner as *Sauté de Veau Marengo*, on p. 63.

TENDONS OF VEAL À LA PORTUGAISE

Prepare the tendons as in the preceding recipes and cook in the same manner as *Sauté de Veau à la Portugaise*, on p. 64.

TENDRONS OF VEAL WITH TARRAGON

Prepare the tendrons as in the preceding recipes. Brown them in a little oil, then drain off the oil and sprinkle with a little flour. Stir and cook for a few minutes. Then add gradually 6 tablespoons of butter and $\frac{1}{2}$ pint of water. Bring to the boil, add a bouquet of mixed herbs, season with salt and pepper, cover and simmer in the oven for $1\frac{1}{2}$ hours. To serve, put the pieces of veal on a hot dish, mix 1 tablespoon of chopped tarragon with the strained sauce and pour over the meat. Garnish each slice with blanched tarragon leaves.

VEAL À LA BOLIVARA

Cut a shoulder of veal into 3-inch lengths, free from fat and gristle, and brown in hot oil and butter. Then add 1 tablespoon of chopped onion and cook till brown. Cover with $\frac{1}{2}$ pint of Tomato sauce (see p. 120), 4 tablespoons of white wine, season with salt and pepper and add a bouquet of herbs. Cover and simmer in the oven for $1\frac{1}{2}$ hours. Put the pieces of veal in another saucepan, strain the sauce over them and add 1 lb. of sliced tomatoes, sauté in oil, and $\frac{1}{2}$ lb. of stoned olives. Simmer for a few minutes only, without boiling, and serve on a hot dish. Sprinkle with a little chopped parsley.

VEAU AUX OLIVES

Brown 2 lbs. of fillet of veal in hot fat, turning it occasionally so that it is equally browned on all sides. Remove from the saucepan, and in the same fat brown 1 large chopped onion and 1 or 2 cloves of chopped garlic. Add 1 tablespoon of tomato purée (see p. 123), put the meat back in

the saucepan, moisten with $\frac{1}{2}$ pint of water, season with salt and pepper, cover and simmer for 2 hours. Half an hour before serving add 2 dozen stoned olives.

VEAL WITH PAPRIKA

Chop 3 onions and brown in hot lard. Sprinkle with 1 tablespoon of paprika, add 1 lb. of lean veal, cut in small squares, and season with salt. Add a little water and simmer till the water has evaporated. Repeat this process till the meat is quite tender.

VEAU ÉTUVÉ AU VIN ROUGE

Cut $1\frac{1}{2}$ lbs. of breast of veal in small cubes and brown in an earthenware casserole in $2\frac{1}{2}$ ozs. of butter. Then add 2 wineglasses of red wine, 2 whole cloves of garlic, a bayleaf, salt and pepper, cover and simmer in the oven for 2 hours. Half an hour before serving mix 1 tablespoon of flour with 1 wineglass of red wine and mix with the sauce. Serve in the casserole.

VITELLO TONNATO (Italian)

(Veal with Tunny Fish and Anchovies)

Remove all fat and gristle from 2 lbs. of fillet of veal. Take 2 anchovies (in brine), wash them, cut them in half and remove the bones. Divide into 8 thin strips and lard the fillet of veal with them, and tie the meat up with string. Put sufficient water in a saucepan to cover the meat, add 1 whole onion, stuck with 2 cloves, 2 sliced carrots, 1 stick of celery, a bayleaf and a handful of coarse salt. Bring to the boil and add the veal. Simmer for $1\frac{1}{2}$ hours, then

remove the meat from the water and drain thoroughly. Carve into very thin slices, and put these slices in an earthenware vessel or casserole only just sufficiently large to hold them, so that they will be closely packed. Cover with the following sauce: Wash and bone 2 anchovies and pound in a mortar with 4 ozs. of tunny fish (in oil). Then add oil gradually, as in the making of mayonnaise, and finally add the juice of 1 large lemon. The sauce should be somewhat liquid and there should be sufficient to cover the meat. Sprinkle with 2 tablespoons of capers and let stand in a cold place for a day or two. To serve, arrange the slices of veal on a dish, pour the sauce over them and garnish with slices of lemon.

ROAST VEAL

See directions for roasting on p. 17 (Methods of Cooking).

ROAST FILLET OF VEAL, LARDED

Lard the fillet of veal carefully (see Larding, p. 124) and roast according to directions on p. 17 (Method of Cooking).

FILLET OF VEAL CHASSEUR

Lard the fillet of veal closely and roast. Serve with a Chasseur sauce (see p. 115) in a sauceboat.

FILLET OF VEAL À LA

Roast 3 lbs. of fillet of veal, and when done carve in neat slices. Between each slice put a layer of thick Béchamel sauce (see p. 114), and arrange the fillet so that it does not appear to have been carved. Cover with Béchamel sauce

to which the whites of 2 eggs, stiffly beaten, have been added. Pour 1 tablespoon of melted butter over the whole and put in a quick oven to glaze. Garnish with potato croquettes.

ROAST VEAL WITH HERBS

Put 2 lbs. of fillet of veal on a trivet in a meat tin, season with salt and pepper, and pour 2 tablespoons of melted butter over it. Then sprinkle over the meat 1 finely chopped onion mixed with 3 sprigs of chopped parsley, 1 teaspoon of chopped tarragon, 1 of chopped marjoram, $\frac{1}{2}$ of sweet basil, $\frac{1}{2}$ of fennel, 1 sprig of rosemary, a pinch of allspice, and lastly add the juice of 1 lemon. Roast the meat in the usual way. Ten minutes before serving remove the dish from the pan and place on a hot dish. Pour the sauce from the pan, mixing with the onion and herbs with which the meat was flavoured. Put 2 tablespoons of hot water in the meat pan to detach the remaining gravy. Add the juice of $\frac{1}{2}$ lemon. Mix 1 well-beaten egg with 1 heaped tablespoon of fine white breadcrumbs, spread this over the meat, then pour the gravy over the whole and put in a brisk oven for 5 to 8 minutes.

ROAST FILLET OF VEAL WITH PEAS

Roast the fillet of veal and place it on a layer of green peas, previously boiled, well drained, and cooked for 5 minutes in a Béchamel sauce (see p. 114).

ROAST FILLET OF VEAL WITH PAPRIKA

Lard the fillet, season with salt and 1 tablespoon of paprika and roast, putting the meat on sliced onions and basting frequently with butter. When done, place on a hot dish, garnish with clusters of cooked cauliflower, coated

with Béchamel sauce (see p. 114) to which a little paprika has been added and a little chopped ham, and with plain boiled potatoes.

ROAST FILLET OF VEAL WITH MUSHROOMS

Roast the fillet of veal, put on a hot dish, strain a little of its gravy over it, garnish the dish with mushrooms sauté in butter, sprinkle these with a little parsley and serve with Madeira sauce (see p. 117).

ROAST FILLET OF MARINATED VEAL

Lard 2 lbs. of fillet of veal, put in an earthenware vessel with a marinade of equal parts of white wine and water, 1 tablespoon of vinegar, sliced onions, carrots, mixed herbs, 2 bayleaves, a handful of coarse salt and 12 peppercorns. Let stand for 24 hours in a cool place, turning the meat frequently. Wipe it quite dry and roast. Serve with a Piquante sauce (see p. 119).

ROAST LOIN OF VEAL

Bone the loin, stuff with veal forcemeat (see p. 121), tie up and roast. Serve with rolls of fried bacon and garnish with lemon. Serve with the sauce in a sauceboat.

ROAST LOIN OF VEAL WITH TOMATOES AND MUSHROOMS

Roast the loin of veal and garnish the dish with cooked sliced tomatoes and cooked mushrooms. Serve with a Chasseur sauce (see p. 115).

ROAST LOIN OF VEAL WITH KIDNEYS

Roast the loin of veal and garnish the dish with 2 veal kidneys, thinly sliced and cooked in butter. Serve with Tomato sauce in a sauceboat (see p. 120).

ROAST SHOULDER OF VEAL

Stuff the shoulder of veal in the same manner as in any of the recipes given for Stewed Shoulder of Veal (see p. 64) and roast it. Serve with the gravy from the pan.

VEAL WITH BEER (German)

Lard a loin of veal, season with salt and pepper, and put it in the meat tin on sliced onions and carrots, baste with butter, and cook for $\frac{1}{2}$ hour till evenly done on all sides. Then pour 1 glass of beer over the meat, add 1 bayleaf and 2 cloves, and cook till the meat is tender, basting frequently. When done, put the meat on a hot dish, strain the sauce, thicken with 1 tablespoon of flour and pour over the meat.

VEAL À LA DAME BLANCHE

Roast either a fillet or loin of veal, and when cold have ready the following sauce: Put 2 tablespoons of vinegar in a saucepan with 2 cloves, a blade of mace, 1 bayleaf, 1 tablespoon of chopped gammon, and a few peppercorns. Cook for 10 minutes, then add $\frac{3}{4}$ pint of Béchamel sauce (see p. 114) and reduce till rather thick. Add 1 gill of aspic jelly and stir. Remove from the fire, and when cool add 6 tablespoons of whipped cream. Coat the meat with this and put on ice or stand in a cold place till the sauce is firm.

SUNDRIES

ARROSTINI ANNEGATI

(Loin of Veal à l'Italienne)

Cut 6 veal chops with the kidney attached. Skewer so that they will keep together. Put 2 ozs. of butter in a frying pan with a sprig of rosemary. Add the chops, well seasoned and coated with flour. Cover the pan with a dish and allow to cook very slowly, turning and basting the chops frequently. When nearly done, add a glass of good white wine—sweet Orvieto is the most usual—and simmer for a few minutes. Remove the chops, add a little butter to the sauce, stir well and pour over the chops. Serve with either a potato purée, or spinach à l'Italienne which is made by mixing 2 ozs. of butter to every 1 lb. of cooked, coarsely chopped and drained spinach, and adding, 5 minutes before serving, 1 heaped tablespoon of raisins and 1 heaped teaspoon of pine kernel nuts.

VEAL AND HAM PIE

Cut 1½ lbs. of lean veal, free from fat and gristle, into neat slices, and cut ¼ lb. of cooked ham in similar pieces. Put a layer of veal in a pie-dish, cover with a layer of ham, and over the ham put sliced hard-boiled eggs. Continue till the dish is filled, seasoning each layer with salt, pepper, chopped parsley and mixed herbs. Add 1 gill of veal stock cover with a lid of pastry, decorate with paste leaves, leave an opening in the centre for the steam to escape, brush over with yolk of egg, and bake in a moderate oven for about 1½ hours.

VEAL PUDDING

Cut 1½ lbs. of lean veal into small squares, and cut ½ lb. of uncooked ham or pickled pork into thin strips. Line a

well-greased basin with suet paste, put in the meat alternately with the ham or pork and season with salt and pepper. Fill the basin three-quarters full with boiling water, put on a thin lid of paste, cover with buttered paper and steam for 3 hours. Serve with gravy (see p. 117).

Mutton and Lamb

BOILED MUTTON OR LAMB

BOILED LEG OF MUTTON

See p. 19 for observations on boiling of meat. Put the leg of mutton in a saucepan of hot water or stock with just sufficient water to cover, bring to the boil and skim carefully. Then add, for a 6 to 7 lb. leg of mutton, 1 large carrot cut in half lengthwise, 1 large onion, halved and stuck with 2 cloves, 1 turnip and 1 leek, 1 tablespoon of salt, 12 peppercorns, 2 bayleaves and a sprig of parsley, thyme and marjoram. Cover the saucepan, leaving an opening for the steam to escape, and simmer gently, allowing 25 minutes to the lb. Turn the meat occasionally, but do not use a fork, as the skin should not be pierced. When done, drain, put on a hot dish and garnish with onions and carrots or other vegetables, cooked separately. The vegetables used in the cooking of the mutton will be overdone and should not be sent to table. They can be used for making purées, etc. Serve with Béchamel sauce (see p. 114) to which capers have been added and cooked for about 5 minutes.

BOILED KNUCKLE OF LAMB

Proceed as in the foregoing recipe, allowing 20 minutes to the lb. Serve with Onion or Soubise sauce (see p. 120).

BOILED LEG OF MUTTON WITH GOOSEBERRY OR APRICOT JELLY (Arab)

Boil the leg of mutton as directed in Boiled Leg of Mutton (see p. 74), and when done drain, put on a hot dish and cover with either gooseberry or apricot jelly.

BREAST OF MUTTON, STUFFED AND BOILED

Stuff the breast of mutton with a stuffing made with the finely chopped heart, chopped gammon, bread soaked in milk and well squeezed, 1 egg, mixed herbs and a seasoning of salt and pepper. Sew up the shoulder carefully and boil in the same manner as Boiled Leg of Mutton (see p. 74).

GIGOT À L'EAU (French)

Make a dozen or so incisions in the leg of mutton, and in each put a peeled clove of garlic. Put in a saucepan with sufficient hot water to cover, season with 1 tablespoon of salt, and 12 peppercorns. Bring to the boil and simmer for 4 hours. Remove from the water, drain, and brown the leg of mutton in butter or fat, turning so that it is equally browned on all sides. Put on a hot dish. Put a little hot water in the pan in which the meat was browned, scraping the sediment with a spoon and mixing with the water, then add a lump of butter and a little vinegar and pour the whole over the meat.

GIGOT WITH TURNIP PURRY (Scotch)

The Scotch still retain the French word *gigot* (leg of mutton or lamb) in their culinary vocabulary, and the word "purry" also came from the French word *purée*. Proceed

in the same manner as for Boiled Leg of Mutton (see p. 74), and when done serve with a turnip purée (see p. 123) and Béchamel sauce (see p. 114), to which capers have been added and cooked for 5 minutes.

LEG OF MUTTON WITH OYSTERS

Bone the leg of mutton and stuff with the following mixture: Blanch 1 dozen oysters in their own liquor and strain the latter. Chop the oysters coarsely and mix with 1 tablespoon of breadcrumbs, 2 hardboiled yolks of egg, 1 finely chopped shallot, a little parsley, season with salt and pepper and moisten with a little of the oyster liquor. Press into the cavity from which the bone was removed and bind with string. Boil in the same manner as indicated on p. 74 (Boiled Leg of Mutton) and serve with Oyster sauce (see p. 118).

MUTTON HAM

See directions for salting or curing meat on p. 110. It is boiled in the ordinary way.

SALTED BREAST OF LAMB (Norwegian)

Rub the breasts of lamb with 3 tablespoons of salt, 1 teaspoon of saltpetre, and 1 tablespoon of brown sugar—for 3½ lbs. of meat. Stand for 4 to 5 days, turning every day. Boil in the ordinary way and serve with mixed vegetables.

SPICED LEG OR SHOULDER OF MUTTON

Mix 8 ozs. of common salt with 1 oz. of bay salt, ¾ oz. of saltpetre, 4 ozs. of brown sugar, 1 teaspoonful of pepper,

1 tablespoon of finely chopped shallot or onion, $\frac{1}{2}$ teaspoon of allspice and the same of powdered cloves. Mix all these ingredients thoroughly and rub thoroughly into the meat, which should be boned. Repeat daily for 15 days. Rinse the meat in warm water before cooking, and boil in the same manner as Boiled Leg of Mutton (see p. 74). When done, press between two dishes until cold and glaze.

BRAISED AND STEWED MUTTON AND LAMB

BREAST OF LAMB SAINTE-MENEHOULD

Line an earthenware casserole with rashers of fat bacon, and over these put the breast of lamb. Cover with gammon, cut in small dice, with 2 sliced carrots, 4 chopped onions, and add 2 bayleaves, a little thyme, 1 gill of stock, and season with salt and pepper. Cover with a sheet of buttered paper, put the lid over this and simmer in a moderate oven for 3 hours. When done, bone the breast, season with salt and pepper, egg and breadcrumb it, and brown on a buttered dish in the oven. Serve with thin gravy.

BREAST OF LAMB, STUFFED AND BRAISED

Bone the breast of lamb, flatten, cover with a layer of veal forcemeat (see p. 121), roll up tightly and tie. Braise for 2 hours in the oven (see p. 20, Methods of Cookery). When done, put on a hot dish and garnish with French beans, previously boiled, drained and mixed with melted butter, and serve with either an Espagnole sauce or Gravy (see pp. 116, 117) in a sauceboat.

COLLARED BREAST OF MUTTON

Bone a breast of mutton and stuff with the following mixture: 2 tablespoons of breadcrumbs, 1 tablespoon of finely chopped capers, 1 teaspoon of chopped parsley,

$\frac{1}{2}$ teaspoon of powdered mixed herbs, a pinch of nutmeg, salt, pepper and 1 egg. Braise for $2\frac{1}{2}$ hours (see p. 22, Methods of Cooking), and when done put the meat in an earthenware casserole, strain the stock over it, add half its quantity of vinegar and 1 tablespoon of salt. The meat should be completely covered. Let stand for 5 or 6 days. If kept for longer the marinade should be boiled every day and the meat put back in it when cold.

POITRINE DE MOUTON EN CARBONNADE

Bone the breast of mutton and divide the meat into small oval shapes. Proceed as in the recipe for Breast of Lamb Sainte-Menehould (see p. 77). When done, put on a hot dish and cover with either cooked endive or spinach or sorrel, or with a purée of onions (see p. 123) or Tomato sauce (see p. 120).

CASSOULET DE MOUTON

Bone a leg of mutton and stuff with a mixture of chopped pickled pork, seasoned with garlic and parsley. Sew up and tie with string and braise it. When nearly done, place on a large oval deep fireproof dish. Strain the sauce and mix with haricot beans prepared as follows: Soak 1 lb. of haricot beans in cold water for 12 hours. The next day put them in a large saucepan, cover with cold salted water, bring to the boil and simmer till they begin to get tender. Then add 3 cloves of garlic, $\frac{3}{4}$ lb. of sliced fat bacon, cook for an hour and add some large pork sausages. When done, drain thoroughly. Brown 1 large chopped onion lightly in fat, add 2 tablespoons of Tomato purée (see p. 123), 1 glass of white wine, a few tablespoons of stock, and add the haricot beans, seasoning highly with salt, pepper and 2 or 3 cloves of garlic. Mix all well, put half of the haricot beans in a deep and long earthenware fireproof dish, and over them

place the mutton, cover with more haricot beans, garnish with the sliced sausages and sliced bacon, sprinkle with chopped garlic, parsley and breadcrumbs and brown in the oven.

CIVET DE MOUTON

Lean pieces of mutton from the leg or the loin are used for this dish. Divide into pieces and put in an earthenware casserole or terrine with 1 or 2 sliced onions, a seasoning of salt and pepper, and moisten with a few tablespoons of oil and brandy. Let stand for 3 hours. Brown $\frac{1}{4}$ lb. of bacon or gammon, cut in dice, in $1\frac{1}{2}$ ozs. of butter and the same quantity of pork fat, and when browned remove from the saucepan or casserole. In the same fat brown 2 medium sized onions, cut into quarters. When done, remove from the pan and put in the pieces of mutton, which should have been well dried in a cloth. As soon as they begin to brown, sprinkle with flour, mix well, and when the flour is also brown cover the pieces with red wine and add 1 clove of garlic. Stir and bring to the boil and simmer very gently for 2 to $2\frac{1}{2}$ hours. Put the pieces of mutton in a clean casserole with the diced gammon, 20 button mushrooms cooked in butter, and 20 pickling onions browned in butter. Strain the sauce over the whole, cook for a few minutes, and garnish with croûtons of fried bread.

CURRIED LAMB

See recipe for Curried Beef (p. 51).

HARICOT OF MUTTON

Trim the cutlets from 2 lbs. of neck of mutton and brown thoroughly in a little butter or fat. When done, remove from the saucepan and brown 2 sliced onions in the same fat. Sprinkle with a little flour, mix thoroughly, put the

meat back in the saucepan, cover with $\frac{1}{2}$ pint of boiling water, bring to the boil; skim carefully, then add 2 sliced carrots, 2 small turnips, a sprig of thyme, parsley, bayleaf, and season with salt and pepper. Simmer for $1\frac{1}{2}$ to 2 hours till the cutlets are tender. To serve, place the meat in the centre of a hot dish, garnish with the vegetables and strain the sauce over the whole.

HARICOT DE MOUTON (French)

Brown $\frac{1}{2}$ lb. of gammon in lard, cut in large dice, as well as 20 pickling onions. Remove from the saucepan and brown the trimmed cutlets in the same fat, adding 3 cloves of garlic, crushed with the blade of a knife, and sprinkling with $1\frac{1}{2}$ ozs. of flour. Drain off some of the fat and cover the meat with hot water. Add a bouquet of mixed herbs, season with salt and pepper, bring to the boil and simmer for 1 hour. Put the meat in another saucepan with the gammon, the onions, $\frac{1}{2}$ pint of haricot beans, previously soaked for 12 hours and boiled in salted water till almost tender. Strain the sauce over the whole, cover and simmer slowly in the oven till the beans are quite tender. This is usually served in small terrines.

HOT-POT (Lancashire)

Divide 2 lbs. of the best end neck of mutton into cutlets and neatly trim off the skin and fat. Brown in a little butter or dripping and place in a deep fireproof dish, seasoning with salt and pepper and a pinch of sugar. Slice 3 sheeps' kidneys and lay them over the meat, then add a few mushrooms, 18 or 20 oysters in layers, and finally add 2 lbs. of thickly sliced potatoes, neatly arranged and completely covering the whole. Pour $\frac{3}{4}$ pint of stock over this, cover with a lid or with paper and bake in a moderate oven for

2 hours. About 15 minutes before serving remove the lid or the paper so that the potatoes can brown. Serve in the dish in which it was cooked.

IRISH STEW

Divide 4 lbs. of neck of mutton into 8 or 10 trimmed chops, paring off all excess of fat and rough bone (a most necessary precaution), and season highly with pepper and moderately with salt. Place the chops in a deep dish with sufficient water to cover, add 8 good-sized onions, put the lid on and set the whole on the fire to stew gently for $\frac{1}{2}$ hour. The stew must then be removed from the fire, the liquor poured into a basin and, after being freed from all fat (this is essential), is poured back on the chops. Add a dozen peeled potatoes, and a pint of good stock or gravy—or a like quantity of water. Boil gently for $\frac{3}{4}$ hour. To serve, put the potatoes in the centre of a hot dish, arrange the cutlets neatly around them, and pour the sauce and the onions over the whole. It should be served very hot.

BRAISED LEG OF MUTTON

Bone the leg of mutton and braise (see p. 20, Methods of Cooking) very slowly, allowing 40 minutes to the lb. To serve, put on a hot dish, strain the sauce into a small saucepan, bring to the boil, skim, and reduce to $\frac{1}{2}$ pint. Pour over the meat and put in a quick oven for a few minutes to glaze. Serve with it a purée of potatoes, or haricot beans or cauliflower, etc.

GIGOT À LA BORDELAISE

Bone the leg of mutton, lard it with somewhat thick strips of uncooked ham, and fill the cavity from which the

bone was removed with a stuffing composed of $\frac{3}{4}$ lb. of lean veal, finely chopped, about 6 ozs. of bread, soaked in milk and well squeezed, 6 ozs. of butter, and 2 whole eggs. Season with salt and pepper and 2 ozs. of finely chopped onion, lightly browned in butter, and 1 teaspoon of chopped parsley added, well mixed, and cooked till lightly browned. Sew up the opening, brown the meat in hot fat and braise (see p. 22) allowing from 40 to 45 minutes to the lb. When the mutton is three-quarters cooked, add $1\frac{1}{2}$ lbs. of gammon, previously blanched, 2 lbs. of carrots and 1 lb. of turnips, quartered, and surround with the gammon, cut in rectangular shapes. Serve with a Tomato sauce (see p. 120) to which a little of the reduced sauce from the braising has been added.

GIGOT BRAISÉ À LA LYONNAISE

Lightly colour the leg of lamb in butter, then add sufficient hot water just to cover the meat, season with salt, bring to the boil, and boil rapidly till all the water has evaporated. Add a large lump of butter, 2 or 3 tablespoons of Tomato sauce (see p. 120), moisten with a little hot water, cover closely and simmer for 5 to 6 hours. To serve, put on a hot dish and pour the sauce over it. It is usually garnished with some kind of vegetables—the bottom of artichokes, French beans, peas, etc.

GIGOT DE MOUTON À LA PROVENÇALE

Bone the leg of mutton and fill the cavity with a stuffing of chopped pickled pork, bread soaked in milk and well squeezed, a clove of garlic, a bouquet of mixed herbs, salt, pepper and 1 whole egg. Sew up the opening and braise the meat. When the meat is well browned, add a glass of white wine and 1 gill of stock. Simmer, allowing 40 minutes

to the lb. To serve, put on a hot dish and garnish with sliced aubergines, a few sliced onions, both cooked in oil, 4 chopped tomatoes, 2 chopped cloves of garlic, cooked in oil with a little thyme, and fennel. Strain a little of the sauce over the whole.

GIGOT SOUBISE

Braise the leg of mutton, and when three-quarters done put it in another saucepan, with $1\frac{1}{2}$ lbs. of shredded blanched onions and $\frac{3}{4}$ lb. of rice. Strain the sauce from the braising pan over the whole, cover and simmer gently till the rice and onions are cooked. To serve, put the meat on a hot dish, rub the onions and rice through a sieve, add a little butter, and serve this purée separately.

LE NAVARIN (French Mutton Stew)

Use 2 lbs. of mutton taken from the boned shoulder, the breast and the middle neck. Divide into pieces weighing from 2 to $2\frac{1}{2}$ ozs. each, and brown in 2 ozs. of lard. Season with salt, pepper and a good pinch of sugar, which helps to give a good colour to the sauce. Cook on a brisk fire, turning the pieces of meat frequently, and brown thoroughly. Pour away most of the lard and sprinkle the meat with flour and cook till brown. Now add $1\frac{1}{2}$ quarts of hot water, bring to the boil, skim, season with salt and peppercorns, add 1 clove of garlic, peeled and well crushed with a knife, and simmer very gently for 1 hour. Remove the pieces of mutton from the saucepan and put in a clean saucepan. Skim the sauce carefully, and strain over the meat. Bring to the boil, add 12 pickling onions, previously browned in butter, and 15 minutes later add 2 lbs. of small peeled potatoes. Cover and simmer for $\frac{3}{4}$ hour. A few minutes before serving, remove the saucepan from the fire and skim

any grease that may rise to the surface. To serve, put the mutton in the middle of a hot dish, surround with the vegetables, and pour the sauce over meat and vegetables.

LE NAVARIN PRINTANIER

Proceed exactly as in the foregoing recipe, but besides new potatoes and pickling onions, use new carrots, turnips, peas and French beans.

LE RAGOÛT DE MOUTON

Proceed as in the making of Navarin, but omitting all the vegetables. Half an hour before the *ragoût* is to be served, add $\frac{1}{2}$ lb. of Carolina rice. Cook till the rice has absorbed nearly all the sauce.

RAGOÛT DE MOUTON AU RIZ ET AUX CHAMPIGNONS

Proceed as in the foregoing recipe, adding a few mushrooms at the same time as the rice.

BRAISED SADDLE OF MUTTON À LA BOURGEOISE

Braise the saddle of mutton as indicated on p. 20 (Methods of Cooking), and garnish with carrots turned to the size of large beans, with onions, browned in butter, and with strips of blanched larding bacon. Strain the sauce over the whole.

BRAISED SADDLE OF MUTTON À LA DAUPHINE

Braise the mutton and, when done, put on a hot dish, garnish with Potato Croquettes, and strain the sauce over the meat.

BRAISED SADDLE OF MUTTON À LA MILANAISE

Braise the mutton, put on a hot dish and surround with cooked spaghetti mixed with Tomato sauce (see p. 120), butter, and grated Parmesan cheese.

SAUTÉ D'AGNEAU CHASSEUR

Cut 2 lbs. of either breast, shoulder or neck of lamb in pieces weighing $1\frac{1}{2}$ to 2 ozs. each. Season with salt and pepper and cook in oil and butter till well browned and tender. Put them on a dish. Pour all the oil and butter from the saucepan, and put in 3 tablespoons of white wine, reduce over a quick fire, put the pieces of lamb back in the saucepan and add a little Chasseur sauce (see p. 115)—not quite enough to cover the meat. Simmer for 5 minutes, put on a hot dish and sprinkle with chopped parsley.

SAUTÉ D'AGNEAU PRINTANIER

Cut the meat as in the foregoing recipe, and brown lightly in butter with 1 chopped onion. Add 2 tablespoons of tomato purée (see p. 123), reduce, and add sufficient stock to barely cover the meat, 1 glass of white wine, a bouquet of mixed herbs, and 1 clove of garlic, bring to the boil and skim. Half an hour after, put the pieces of lamb in a clean saucepan and strain the sauce over them, and add 2 dozen small carrots and turnips, previously blanched, and simmer till the vegetables are done. Ten minutes before serving, add a handful of cooked peas and French beans.

BRAISED SHOULDER OF MUTTON WITH TURNIPS

Bone the shoulder and stuff it with pork sausage meat (see p. 122). Braise it, and when three-quarters done, put in a clean saucepan, and surround with $2\frac{1}{2}$ lbs. of small

turnips, previously tossed in butter with a pinch of sugar, and with 20 small onions, browned in butter. Strain the sauce over it, and simmer till the meat is quite tender.

ÉPAULE DE MOUTON OU D'AGNEAU À L'AIL

Bone the shoulder and stuff it with pork sausage meat (see p. 122). With a sharp knife, make several incisions on both sides of the shoulder, and in each put a clove of garlic. Braise, put on a hot dish and strain the sauce over the meat.

SHOULDER OF MUTTON À LA SAINTE-MENEHOULD

Proceed as in Breast of Lamb à la Ste.-Menehould, p. 77.

SHOULDER OF MUTTON WITH RICE

Braise the shoulder of mutton and when three-quarters done, put in another saucepan, add $\frac{1}{2}$ lb. of blanched rice, and strain the sauce over it. Simmer till the rice has absorbed nearly all the sauce.

STUFFED SHOULDER OF MUTTON BONNE-FEMME

Bone the shoulder of mutton and stuff with pork sausage forcemeat (see p. 122). Put in the oven, on a meat tin, and cook till half done, basting frequently with butter. Then put it in an earthenware fireproof dish, with $\frac{1}{2}$ pint of haricot beans, previously cooked till nearly done, $3\frac{1}{2}$ ozs. of chopped carrots, cooked with the beans, the same of chopped onions, sautés in butter, and $\frac{1}{2}$ clove of crushed garlic. Season with salt and pepper, moisten with the butter used for basting the meat, and simmer in the oven till done.

TADJIN AHMAR (Turkish Stew)

Cut 2-inch length pieces from either the breast or neck of mutton and brown in a little fat or butter, in an earthenware casserole. Add 1 finely chopped onion, and when lightly browned sprinkle with a little flour and stir till this also browns. Now add sufficient hot water to cover the meat, bring to the boil, season with salt, cover the casserole and simmer. After a few minutes, add a good pinch of saffron, either pounded in a mortar or moistened with a little boiling water, and a small stick of cinnamon. Simmer for 2 hours. Now add a good handful of prunes, previously soaked for 12 hours, and simmer for 1 hour longer. The Arabs usually flavour the stew with orange flower water and add sugar to make it distinctly sweet. Serve in the casserole in which it was cooked.

ROAST MUTTON AND LAMB

BONED AND STUFFED SHOULDER OF MUTTON OR LAMB

Bone the leg of mutton or lamb, fill the cavity with highly seasoned veal forcemeat (see p. 121), and roast according to directions on p. 17 (Methods of Cookery). Baste frequently and serve with the gravy made by mixing a few spoonful of hot water with the sediment in the meat tin.

BONED AND STUFFED LOIN OF MUTTON OR LAMB

Bone the meat and trim off any superfluous fat. Stuff as in preceding recipe, sew up and roast. Serve with gravy, and veal forcemeat balls (see p. 121).

FOREQUARTER OF LAMB

Much care is necessary in the roasting of lamb, and constant basting is required. Lamb should be well-done, and unless the temperature of the oven is well regulated, and the meat constantly basted, the thinner pieces are apt to get dry and hard. The forequarter should be basted at least every 10 minutes. Serve with Mint sauce (see p. 118).

GIGOT À L'AIL

(Leg of Lamb with Garlic)

Dredge the meat with salt, and insert 1 or 2 peeled cloves of garlic under the skin, near the bone. Roast and baste frequently with a little butter. Serve with the gravy from the meat and the diluted sediment from the meat tin.

GIGOT AU GENIÈVRE

(Leg of Lamb with Juniper Berries)

Bone the leg of lamb, make incisions in the meat and fill with juniper berries, being careful to insert them somewhat deeply. Wrap in a damp cloth and let stand in a cool place for 4 or 5 days. Roast, basting frequently with a little butter and salted water to which a few juniper berries have been added. Serve with the strained bastings from the meat pan.

GIGOT À LA CATALANE

Bone a leg of mutton or lamb, brown in pork fat, season highly with salt and pepper, and add 15 cloves of garlic, 1 shredded pimiento, sprinkle with a little flour, moisten with hot stock or water, 6 tablespoons of white wine, and 1 tablespoon of tomato pulp (see p. 124). Simmer in a slow oven, basting frequently.

GIGOT D'AGNEAU SOUS CROÛTE

(Leg of Lamb in a Crust)

Brown the leg of lamb lightly in the oven. Then spread over with a layer of sausage meat (see p. 122) mixed with 2 ozs. of finely chopped fat bacon and 1 truffle, all rubbed through a sieve. Wrap the leg in a piece of caul, place it on sheet of pastry made with flour, lard and water, and completely surround the leg of lamb with the paste, leaving a slight opening for the steam to escape. Bake in a moderate oven for $1\frac{1}{2}$ hours. Remove from the oven, pour 6 table-spoons of Espagnole sauce (see p. 116) through the opening, and serve in the crust, which should be removed only when the meat is about to be carved.

HINDQUARTER OF LAMB

See Forequarter of Lamb, p. 88.

HUNTER'S MUTTON

Bone a leg of mutton and score closely. Mix 8 ozs. of common salt with 4 ozs. of bay-salt, $1\frac{1}{2}$ ozs. of brown sugar, 1 oz. of saltpetre, 1 teaspoon of allspice, $\frac{1}{2}$ teaspoon of ground cloves, and $\frac{1}{2}$ a grated nutmeg. Rub the meat over with this, and let stand in a cool place for 15 days, rubbing the pickling ingredients into the meat every day. When ready, rinse in hot water, dry thoroughly, put in a baking tin, cover with a few strips of fat bacon and roast. When done, put between two dishes, placing a weight on the upper one, and stand till cold.

ROAST LEG OF LAMB

See Roast Forequarter of Lamb. Allow 20 to 25 minutes to the lb., and 20 minutes over. Serve with Mint sauce (see p. 118).

ROAST LEG OF MUTTON

See Roast Forequarter of Lamb (p. 88). Allow the same time as in preceding recipe. Serve with red currant jelly.

ROAST LOIN OF MUTTON OR LAMB

Same as roast leg of lamb or mutton.

ROAST NECK OF MUTTON

Same as foregoing recipes.

ROAST SADDLE OF MUTTON

Same as foregoing recipes.

ROAST SADDLE OF MUTTON OR LAMB WITH GARNISHES

Roast saddle of mutton or lamb can be served with the same garnishes as braised saddle of mutton (see p. 84).

SADDLE OF LAMB À LA BÉARNAISE

Season the saddle of lamb with salt, brush over with melted butter, and roast, basting frequently with butter. Serve with a Béarnaise sauce (see p. 113) to which 2 or 3 tablespoons of the bastings have been added, and garnish with new potatoes lightly browned in butter.

SADDLE OF LAMB À LA BASQUAISE

Cook the lamb as in preceding recipe, and serve with the strained bastings, to which 2 chopped mint leaves have been added, and garnish with new potatoes browned in butter, and grilled almonds.

SHOULDER OF MUTTON À LA BASQUAISE

Make a stuffing with 2 chopped shallots, 4 cloves of garlic, parsley and bread soaked in milk and cook in a little fat till lightly browned, seasoning with salt and pepper. Bind with 1 egg, and stuff the boned shoulder with the mixture. Roast, basting frequently with lard. Serve with blanched pimientos, added to the gravy about 10 minutes before serving.

SHOULDER OF MUTTON STUFFED

Bone the shoulder and stuff with veal forcemeat (see p. 121). Roast, basting frequently and serve with gravy (see p. 117).

Pork

BOILED PORK

LEG OF PORK À LA WIENERSALD

Put the leg of pork in a large saucepan of warm water, bring to the boil and skim carefully. Then add 2 carrots, sliced lengthwise, 1 large onion, stuck with 2 cloves, 1 turnip, mixed herbs, 1 bayleaf, 1 tablespoon of salt, and 8 peppercorns. Simmer gently, allowing 30 minutes to the lb. When done, put on a hot dish, carve into thin slices, and pour the following sauce over them: Quarter 2 lbs. of tomatoes and boil in $\frac{3}{4}$ pint of white wine till reduced to a pulp, and rub through a sieve. Macaroni, or dumplings of some kind, are served with this dish.

SUCKING PIG À LA RusSE

Divide the sucking pig into joints, put in a saucepan and cover with warm water. Do not add either salt or vegetables. Bring to the boil, and simmer for 2 hours, till quite tender. Then add 2 tablespoons of salt and let stand till quite cold. Drain thoroughly, put the pieces of sucking pig on a dish, and cover with a sauce made with 1 heaped tablespoon of grated horseradish, mixed with $\frac{1}{2}$ pint of sour cream, and seasoned with salt and pepper.

BRAISED OR STEWED PORK

BAKENOFF OR BRAISED FILLET OF PORK À L'ALSACIENNE

Put a layer of sliced potatoes and onions in an earthenware casserole, lay over them a small fillet of pork and a small piece of saddle of mutton, season with salt and pepper, add 1 bayleaf, and moisten with 1 gill of stock and 1 gill of white wine. Cover, put in the oven and simmer till tender. Serve in the casserole.

FILLET OF PORK WITH BREADCRUMBS

Brown 3 lbs. of fillet of pork in butter and sprinkle with finely chopped shallots, onion, garlic, parsley and white breadcrumbs, seasoning with salt and pepper. Put in the oven, adding $\frac{1}{2}$ pint of stock, and simmer till tender.

FILET DE PORC MARINÉ

Put 3 lbs. of fillet of pork in an earthenware casserole with $\frac{1}{2}$ bottle of white wine, $\frac{1}{2}$ pint of wine vinegar, 1 onion and 2 carrots, finely chopped, 2 cloves of garlic, 2 sprigs of thyme, and 6 peppercorns. Let stand in a cool place for

12 hours or more. Drain thoroughly, put the pork and vegetables in another casserole, season with salt, and brown evenly on all sides. Then add the marinade, cover, put in the oven and baste occasionally. When the marinade has reduced to about 2 tablespoons, add 3 tablespoons of thick Tomato sauce (see p. 120) and simmer till the meat is tender. Put the pork on a hot dish and strain the sauce over it.

FILLET OF PORK WITH TURNIPS

Put the fillet of pork in an earthenware casserole with a few tablespoons of water, cover, and place in a moderate oven. When the meat begins to brown, add 2 or 3 dozen small turnips, browned in fat and sprinkled with a little sugar. Moisten with 2 tablespoons of stock and 2 of Tomato sauce (see p. 120), and simmer gently till the pork is tender, turning the joint occasionally.

FILET DE PORC SAUCE POIVRADE À LA CRÈME

Proceed as in Filet de Porc Mariné (p. 92), omitting the Tomato sauce, and adding 6 tablespoons of stock. When done, remove the meat from the casserole and keep hot while the following sauce is being prepared: Put all the contents of the casserole in which the meat was cooked in a small saucepan. In the same saucepan in which the pork was cooked, put 6 tablespoons of vinegar and 10 ground peppercorns. Boil rapidly till reduced to 1 tablespoon. Now add the vegetables and liquid in which the meat was cooked, mix well, and add $\frac{1}{2}$ pint of cream, preferably slightly sour cream. Bring to the boil and simmer for 15 minutes. Strain, replace in the saucepan, and thicken with 1 teaspoonful of arrowroot. Carve the fillet, and cover with a thin layer of sauce. Serve the remainder in a sauceboat.

"MAIALE UBRIACO" (Italian)
(Pork Stewed in Red Wine)

Season 3 or 4 lbs. of loin of pork with salt and pepper, and brown in oil, with several cloves of garlic and a little chopped parsley. Add $\frac{1}{2}$ flask of red Chianti, cover and simmer in the oven till the meat is tender and the wine has reduced by half. To serve, put the meat on a hot dish and pour the sauce over it.

PORK STEWED IN BEER (German)

Put 4 lbs. of loin of pork in a saucepan or earthenware casserole with 3 pints of cold water. Bring to the boil, reduce by half and skim carefully. Then add $\frac{1}{2}$ pint of beer (preferably Swiss brown beer), 2 or 3 cloves, 1 tablespoon of sugar, 1 sliced onion, 2 sliced carrots, 1 slice of crust of bread, a bayleaf, salt and peppercorns, and simmer till tender. Place the meat on a hot dish and strain the sauce over it.

SHOULDER OF PORK BRAISED À L'ALSACIENNE

Proceed as in recipe for Bakenoff or Braised Fillet of Pork (p. 92).

ROAST PORK

BREAST OR BRISKET OF PORK WITH APPLES
(German)

Blanch the pork in boiling water for 10 minutes. Remove from the water, scour closely, and rub over with salt. Place in a deep meat tin, with the skin downwards, and pour $\frac{3}{4}$ pint of boiling water over it. Baste frequently, and allow 30 minutes to the lb. After 1 hour the meat should

be turned. Peel, core and quarter 3 or 4 large apples, and put them in a saucepan 2 tablespoons of butter, 2 tablespoons of sugar, 2 tablespoons of currants, and cook till soft. To serve, put the pork on a hot dish and garnish with the apple mixture.

FILLET OF PORK

Crush 1 oz. of bay salt, 12 peppercorns, 2 or 3 sprigs of thyme, 1 bayleaf, a pinch of allspice, with a rolling-pin. Rub this well into a fillet of pork on both sides and let stand for 12 hours or more. Then roast the fillet (see p. 17 for Roasting, Methods of Cooking), basting with a little hot water and allowing 30 minutes to the lb. When done, pour a little white wine and water in the meat tin and scrape the sediment. Pour over the meat or serve in a sauceboat.

FILLET OF PORK WITH APPLE SAUCE

Prepare and roast the fillet of pork as in foregoing recipe. Serve with Apple sauce (see p. 113) in a sauceboat, and the gravy as in the foregoing recipe.

FILLET OF PORK WITH BRUSSELS SPROUTS

Roast the fillet of pork as in preceding recipes. Blanch 1 lb. of Brussels sprouts, drain thoroughly and put in the meat tin 20 minutes before serving. Baste frequently with the gravy from the pork.

FILLET OF PORK, COLD, WITH RED CABBAGE SALAD

Carve the cold pork in very thin slices, put on a dish, garnish with gherkins, and serve with a salad of red cabbage

and apples, and with cold Apple sauce (see p. 113) mixed with a little grated horseradish.

FILLET OF PORK WITH CHARCUTIÈRE SAUCE

Roast the fillet of pork as in preceding recipes and serve with Robert sauce (see p. 119), to which shredded gherkins have been added.

FILLET OF PORK WITH ONION PURÉE

Roast the fillet of pork and serve with an onion purée (see p. 123).

FILLET OF PORK À LA PAYSANNE

Roast the fillet of pork, and when half done, add 2 lbs. of quartered potatoes and 4 shredded onions, lightly browned in butter. Baste the vegetables frequently with the gravy from the pork.

FILLET OF PORK WITH PIQUANTE SAUCE

Roast the fillet of pork, and serve with a Piquante sauce (see p. 119) in a sauceboat.

FILLET OF PORK WITH RED CABBAGE

Roast the fillet of pork, put on a hot dish and surround with Red Cabbage à la Flamande, which is made as follows : Quarter the cabbage, remove the coarse leaves and the ribs from some of the leaves and shred finely. Season with salt, pepper and a little nutmeg, and put in a well-buttered

earthenware casserole with 1 small finely chopped onion, 3 tablespoons of vinegar and the same quantity of water. Cover and simmer gently for 2 to 2½ hours, and adding, 1 hour before serving, 4 small cooking apples, peeled, cored and finely chopped or shredded and 1 or 2 tablespoons of sugar.

FILLET OF PORK WITH ROBERT SAUCE

Roast the fillet of pork and serve with Robert sauce (see p. 119) in a sauceboat.

FILLET OF PORK WITH SAUERKRAUT

Roast the fillet of pork. Braise the sauerkraut, basting it frequently with some of the gravy from the pork. To serve, put the pork on a hot dish and place the sauerkraut around it.

FILLET OF PORK WITH TOMATO PURÉE

Roast the fillet of pork and serve with a tomato purée on a separate dish (see p. 123).

LEG OF PORK

Prepare and roast the leg of pork in the same way as directed for fillet of pork (see p. 92), but scouring the skin closely. Serve with Apple sauce (see p. 113) or any of the sauces and garnishes used for fillet of pork.

LOIN OF PORK

As in preceding recipe. Serve with Apple sauce or any of the sauces and garnishes used for fillet of pork.

LOIN OF PORK, STUFFED

Scour the skin and separate the meat from the bones on the inner sides. Stuff with an onion stuffing made with finely chopped onion mixed with bread and a little parsley and lightly cooked in butter, secure the opening and roast. Serve with the gravy and Apple sauce (see p. 113).

PORK À LA SAUCE PICARDE

Carve the roast pork into thin slices and cook for 10 minutes in a very thick Soubise sauce (see p. 120) to which 1 teaspoonful of vinegar has been added.

ROAST PORK WITH A CRUST (German)

Put 3 or 4 lbs. of fillet of pork in a meat tin, season with salt and pepper and 1 whole onion, a little sage, sweet basil, 1 bayleaf, and pour $\frac{1}{2}$ pint of hot water over the meat. Cook till tender, allowing 30 minutes to the lb. and basting frequently. When done, put on a dish and let stand till cold. Brush the top of the meat with yolk of egg, cover with breadcrumbs, moisten with a little of the gravy, and continue coating the meat with breadcrumbs and gravy till a crust of about $\frac{1}{2}$ inch is formed. Put in a quick oven for 15 minutes, basting frequently. Serve on a hot dish and pour over it the strained bastings, to which 1 glass of white wine has been added.

ROAST SUCKING PIG

Whether stuffed or not, the sucking pig should always be roasted whole. For the average sized sucking pig, allow about $1\frac{1}{2}$ to 2 hours roasting in the oven. If stuffed, allow a little longer. It should be basted with oil, as this renders the crackling crisp. It should be served with good gravy.

ROAST SUCKING PIG STUFFED (1)

Bake $\frac{1}{2}$ lb. of large onions in their skins. When done, remove from the oven and let stand till cold. Peel and chop them very finely. Mix with 1 lb. of bread, soaked in milk and squeezed, 1 lb. of beef suet, finely chopped, 2 ozs. of chopped sage, a seasoning of salt and pepper and 2 whole eggs to bind. Stuff the sucking pig, and sew up the opening. Roast, basting frequently and serve with Apple sauce (see p. 113).

ROAST SUCKING PIG, STUFFED (2)

Make a stuffing with 1 $\frac{1}{2}$ lbs. sausage meat (see p. 122) mixed with $\frac{3}{4}$ lb. of bread soaked in milk and squeezed, 2 cloves of finely chopped garlic, a few sprigs of thyme, and 2 eggs to bind. Cook the whole in a little butter till lightly browned stuff the sucking pig, and sew up the opening. Roast as directed on p. 98, and serve with gravy (see p. 117).

SUCKING PIG À LA BOURGUIGNONNE

Make a stuffing with the chopped lights, liver, heart and kidneys of the sucking pig, mixing with 5 or 6 cloves of chopped garlic, a little parsley, sage, and a seasoning of salt and pepper. Brown the whole in lard, moistening with white wine and a little of the pig's blood. Stuff the pig, sew up the opening and roast. When done, place on a hot dish, put a little white wine in the meat tin and scrape the sediments and serve in a sauceboat.

SUCKING PIG À LA LYONNAISE

Bone the sucking pig, with the exception of the head and the feet. Make a stuffing with the following ingredients :

Boil $\frac{1}{2}$ lb. of bread in milk till the bread has absorbed the milk. Let stand till cold. Then mix with 1 lb. of finely chopped lean veal, 1 lb. of chopped suet, 2 or 3 mushrooms, parsley, chives, 2 shallots, the liver of the pig and an equal quantity of uncooked gammon, both cut in large dice, season with salt and pepper, bind with 4 whole eggs, stuff the pig, and sew up the opening. Put in the meat tin, with sliced onions, a herb bouquet, chives, shallots, basil, and a little white wine. When done, put on a dish and let stand till cold.

SUCKING PIG STUFFED AND ROASTED À L'ALSACIENNE

Rub the inside of the sucking pig with Herb butter (see p. 123). Make a stuffing with the pig's liver, fat bacon, smoked ham, mushrooms, truffles, a little sage, bread, 2 eggs beaten up with a liqueur glass of brandy, and season with salt and pepper. Stuff the pig and sew up the opening. Roast, basting with oil. Serve with a Poivrade sauce (see p. 119).

SUNDRIES

FILLET OF PORK WITH SOUR CREAM

Cut $\frac{1}{4}$ -inch slices from the fillet, removing all fat and bones. Lard with larding bacon (see p. 124), and cook in butter in a sauté pan, browning evenly on both sides. Cover the pan with a dish and simmer for 10 minutes. Then add 1 gill of sour cream and simmer for another 15 minutes. Remove the fillets from the sauce, and put on a hot dish. Stir 1 tablespoon of flour in the sauce, add 1 tablespoon of chopped capers, 1 tablespoon of tomato purée, 1 or 2 tablespoons of stock, stir and mix well, and pour over the fillets.

GALANTINE OF SUCKING PIG

Bone the sucking pig, with the exception of the head. Make a stuffing as follows : Chop 2 lbs. of calves' liver and mix with 2 lbs. of chopped fat bacon, season with salt and pepper, and bind with 4 beaten eggs. Lay the sucking pig flat on a table, and put a layer of stuffing over it. Cover with large dice of fat bacon, of lean ham and lean veal, and over this put another layer of stuffing. Sew up the pig, tie up in a cloth, so that it will retain its shape, and braise it with sliced carrots, onions, thyme, sweet basil, spices, salt, pepper, the bones from the pig, 2 calves' feet, a little stock, and $\frac{1}{2}$ bottle of white wine. Simmer for 4 hours. Put on a dish, strain the sauce over it, and let stand till turned to a jelly.

LOIN OF PORK WITH SWEET SAUCE

Cut the meat from a loin of pork in 3-inch lengths and boil in salted water till tender. Drain, roll in flour, coat with yolk of egg and breadcrumbs, and brown in butter. Put on a dish and cover with the following sauce : Put 1 pint of stock in a saucepan, with 3 tablespoons of port or Madeira and, when warm, add 2 tablespoons each of apple, cherry and plum jam, 1 or 2 tablespoons of honey, $\frac{1}{2}$ teaspoon of grated lemon rind, a little grated cinnamon and 5 pounded cloves. Stir and simmer for 5 or 10 minutes.

PORK À LA BASQUAISE

Brown 3 or 4 lbs. of fillet or loin of pork in a saucepan, seasoning with salt and pepper. Cover with warm milk, and simmer for 2 to 3 hours. Serve, and pour the sauce over the meat.

PORK PIE

Put 1 $\frac{1}{2}$ lbs. of lean pork, free from all bone and gristle, in a saucepan and cover with cold water. Bring to the boil,

skim and add 1 onion and season with salt and pepper. Simmer for 2 to 2½ hours till the meat is tender. Drain and cut into dice. Boil 6 ozs. of lard and 1 gill of water together for a few minutes, add 1 lb. of flour and a good pinch of salt, and stir till sufficiently cool to knead. Work till perfectly smooth, cover and stand in a warm place for ½ hour. Knead the paste again, set aside sufficient to make a lid, and raise the rest into a round or oval form. Fill with the meat, moisten with a little stock, cover with the pastry lid, leaving a small opening in the middle for the steam to escape. Brush the whole with beaten yolk of egg, mixed with a little milk and bake in a moderate oven for 1½ to 2 hours. Remove from the oven and pour in a little more stock through the opening, and let stand till cold. Slices of hard-boiled egg are sometimes added to the meat.

LA TOURTE LORRAINE

Cover a tart plate with a layer of puff pastry and over it put thin strips of lean veal and lean pork, previously marinated for 24 hours in white wine, with a sliced onion, garlic, chopped parsley, cloves, a pinch of nutmeg, salt and peppercorns. Cover, with a layer of pastry, leaving an opening in the centre, and cook in a fairly brisk oven for 25 minutes. Remove the tourte from the oven, and in the opening pour 1 cup of cream mixed with 2 or 3 beaten eggs, and seasoned with salt. Cook for 10 minutes longer.

VARESCHAGA (Russian) (Pork and Beetroot)

Cut 2 or 3 lbs. of loin of pork in 2- or 3-inch lengths, sprinkle with salt, and cook till brown in a little lard.

Remove from the pan and put in a saucepan or earthenware casserole with a few tablespoons of vinegar, 1 small shredded cooked beetroot, and sufficient water to cover. Add 1 chopped baked onion, and season with salt and pepper. Bring to the boil, add 3 tablespoons of breadcrumbs made from rye bread, mix well, bring to the boil, put the meat on a hot dish and pour the sauce over it.

Ham and Salt Pork

BAKED HAMS

Hams require soaking and particularly those which are to be baked. Soak for 12 hours, wipe quite dry, trim away any rusty places underneath, and cover with a paste of flour and water $\frac{1}{2}$ inch thick. Put in a moderate oven and bake for 4 hours. Remove the crust, skin the ham, sprinkle with brown breadcrumbs and serve with Madeira sauce (see p. 117).

JAMBON SOUS CROÛTE

Put the ham in a large boiling pot, cover with cold water, bring to the boil, skim and simmer till the ham is half done, allowing 20 minutes to the lb. Wipe dry, remove the skin, and cover with a layer of the following mixture: Chop 1 or 2 blanched carrots, onions, stick of celery, uncooked ham, $\frac{1}{2}$ bayleaf, a sprig of thyme, drain thoroughly and cook in butter, adding a little Madeira, and seasoning with salt and pepper. When the ham is coated with this, surround with a hot water crust, pressing down the edges, so as to secure them firmly. Leave a small opening on the top for the steam to escape. Put in a moderately hot oven, and after $1\frac{1}{2}$ hours, pour 1 gill of

Madeira in the opening. Replace in the oven and bake for another $\frac{1}{2}$ hour, covering up the opening. To serve, remove the crust, place the ham on a hot dish and serve with Madeira sauce (see p. 117).

JAMBON EN CROÛTE À L'ALSACIENNE

Soak the ham for 12 hours, drain and wipe dry. Surround with a crust made of ordinary bread dough, and cook in a moderate oven, allowing 20 to 25 minutes to the lb.

JAMBON EN CROÛTE À L'Auvergnate

Boil a small ham (see p. 105) and, when almost done, remove from the water and drain. Wipe it dry and remove the skin. Carve the upper side of the ham in neat slices, without, however, removing them. Sprinkle freely with Madeira, and completely surround the ham with bread dough 1 inch thick. Cook in a moderate oven for 1 to 1½ hours, till the bread is a light golden colour and baked through. Serve in the dough, with a Madeira sauce (see p. 117).

JAMBON DU MORVAN

Boil a small ham as directed on p. 105. Remove skin and fat, carve it, but without removing the slices, surround completely with puff pastry, and bake in a quick oven at first, moderating the temperature when the puff pastry begins to colour. Serve with Madeira sauce (see p. 117) and peas, or spinach cooked in butter.

JAMBON DE PRAGUE SOUS CROÛTE

Boil a ham as directed on p. 105. Drain and let stand till nearly cold. Remove the skin and surround the ham with pastry suitable for raised pies. Brush over with beaten

yolk of egg, leave a slight opening in the top of the paste for the steam to escape, and bake in a moderate oven till the paste is a nice golden colour. Just before serving, pour a glass of port or sherry in the opening, cover with a piece of pastry, put the whole on a hot dish, and serve with a little dissolved meat glaze mixed with a few tablespoons of port or sherry.

JAMBON DE PRAGUE METTERNICH

Prepare and cook the ham as in preceding recipe. The following should be served with it: Slices of foie gras (fatted goose livers) sautés in butter, and covered with a slice of truffle, asparagus tips, cooked in butter and Espagnole sauce (see p. 116) flavoured with truffles.

JAMBON DE PRAGUE NORFOLK

Prepare and cook the ham as in preceding recipe. The following should be served with it: Braised sweetbreads, peas, and the strained sauce from the braised sweetbreads.

BOILED HAMS

Hams should be soaked for 12 hours, or longer, if they are highly salted, as in the case of German hams. They should be put in a large, roomy pot or kettle, and completely covered with cold water, the water being changed several times during the 12 hours soaking. To boil, put the ham in a large pot or ham kettle, cover completely with cold water, bring to the boil, skim and simmer, allowing 20 minutes to the lb. When done, drain, remove the skin and any superfluous fat and cover with brown breadcrumbs.

BOILED HAM (French Method)

When the ham is to be served hot, it is cooked as in

preceding recipe, but $\frac{1}{2}$ hour before it is completely cooked the ham is removed from the water and well drained. Remove the skin and some of the fat, and put the ham in a saucepan or earthenware vessel in which it just fits. Then add just over $\frac{1}{2}$ pint of either Madeira, port or some sweet wine. Cover closely, and put in a slow oven for 1 hour. This final braising in wine gives a delicious flavour to the ham. What is left of the wine is used for making a sauce. Another method is to remove the ham from the water when done, drain and place it on a fireproof dish with the wine. Bring to the boil, and simmer, absting constantly with the wine for 20 minutes. Then stop basting and leave the ham in the oven for 8 to 10 minutes longer so as to glaze it.

BOILED HAM (when served Cold)

If the ham is not to be cut till cold, prepare it as follows : Soak it for 24 hours, and put in a large pot or ham kettle and cover with cold water. Bring to the boil, and immediately pour away the water. Again cover the ham, but this time with boiling water, and add 1 or 2 carrots, 1 onion, stuck with 2 cloves, the white part of 2 or 3 large leeks, a few sprigs of parsley, thyme and a bayleaf. Bring to the boil and simmer very gently, allowing from 15 to 20 minutes to the lb. When done, let the ham stand in the marinade till cold. Then remove from the water, drain, take off the skin and any superfluous fat, and cover with aspic jelly and garnish the dish with coarsely chopped aspic.

BOILED HAM WITH BRAISED LETTUCE

Put the braised lettuce in the centre of a hot dish and put the slices of carved ham around it. Serve with the strained sauce from the braised lettuce in a sauceboat.

BOILED HAM À LA MILANAISE

Put the cooked macaroni or spaghetti, mixed with a little Tomato sauce (see p. 120) and grated Parmesan cheese, in the centre of a hot dish, with the slices of boiled ham around, and serve with a Tomato sauce. Or the macaroni may be served separately.

BOILED HAM WITH RISOTTO

Put 3 or 4 ozs. of butter in a deep frying pan, and when melted, add 1 lb. of rice and cook for about 15 minutes, stirring continuously. Then add gradually 1½ pints of hot beef or chicken stock, season with salt and pepper, and simmer till the rice has absorbed the stock. The rice should be moist, but not sodden. Sprinkle with Parmesan cheese, put the rice in the middle of a hot dish, with the slices of boiled ham around, and serve with Tomato sauce (see p. 120).

BOILED HAM WITH SAUERKRAUT

If the ham is served whole, put the braised sauerkraut around it, and garnish with plain boiled potatoes. Serve with an Espagnole sauce (see p. 116) made with a little hock or still Moselle. If the ham is to be served carved, put the sauerkraut and potatoes in the centre of the dish, with the slices of ham around it.

BOILED HAM WITH SPINACH

Proceed as in foregoing recipe, but with braised spinach instead of sauerkraut. Serve with a Madeira sauce (see p. 117).

JAMBON AU NATUREL

Tie a small ham in a cloth, put it in a large saucepan,

cover with hot water, bring to the boil and add 2 carrots, 1 large onion, 2 or 3 cloves, 2 or 3 sprigs of thyme, sweet basil, a bayleaf, 2 or 3 cloves of garlic, a good piece of cinnamon and nutmeg, and a few sprigs of parsley. Simmer, allowing 20 minutes to the lb. When done, let it stand in the marinade till cold. Drain, remove the skin and some of the fat, and cover with breadcrumbs.

BRAISED HAMS

BRAISED HAM WITH MADEIRA SAUCE

Cook the ham as directed in recipe for Boiled Ham (French method) (p. 105). The final braising of the ham should be done in Madeira. Serve with a Madeira sauce (see p. 117).

BRAISED HAM WITH VEGETABLE PURÉES

Braised ham can be served with various vegetable purées (see p. 123), such as purée of lentils, haricot beans, sorrel, spinach, or with macaroni, spaghetti, nouilles, etc.

JAMBON À LA BAYONNAISE

Braise the ham, using Madeira as directed above. Put 2 breakfast cups of rice, previously washed, in a large saucepan of boiling water, and from the minute the water is again on the full boil, allow 13 minutes. Put the rice on a sieve, and either pour a large jug of cold water over it, or hold it under the cold water tap. Drain well and toss lightly with a fork to break up any lumps. Make a Pilaff as follows: Put the rice in a deep frying pan with 2 table-spoons of butter, season with salt, pepper, and cook for a few minutes. Now add 1 large chopped onion, and

gradually 3 pints of stock, and simmer. When half done, add 3 chopped tomatoes, 18 small mushrooms, the same number of chipolata sausages, previously cocked in butter. Ten minutes before serving, pour 2½ ozs. of brown butter over the rice. Serve the Pilaff separately, and Madeira sauce (see p. 117) in a sauceboat.

JAMBON À LA BOURGUIGNONNE

Braise the ham, using white wine and adding a few mushroom peelings to flavour. Serve with Madeira sauce (see p. 117) to which a few sliced mushrooms, previously cooked in butter, have been added.

JAMBON À LA CHANOINESSE

Braise the ham as in the preceding recipe. Serve with nouilles mixed with an onion purée (see p. 123) and a few chopped truffles. Serve with a sauce made with the strained wine in which the ham was cooked.

ROAST HAMS

JAMBON MARINÉ ROTI

Put a small ham in a ham kettle and cover with cold water and white wine in equal proportions. Add sliced carrots, onions, shallots, 2 or 3 cloves of garlic, a few sprigs of thyme, parsley, a bayleaf, and let stand for 24 hours, turning the ham occasionally. Remove the ham from the liquid, dry thoroughly, put it on a trivet in the meat tin, and roast in the oven (see p. 17, Methods of Cooking) basting frequently with its marinade, and allowing 25 minutes to the lb. Ten minutes before serving, remove the skin from the ham and any superfluous fat, cover with breadcrumbs and put back in the oven to brown. Serve with the marinade, which should be strained and reduced.

JAMBON À LA CLERMONTOISE

Proceed as in foregoing recipe. When done, reduce and strain the marinade, replace on the fire, add 4 or 5 peeled and baked chestnuts, and simmer for a few minutes.

ROAST HAM WITH VEGETABLE PURÉES

Prepare and roast the ham as in preceding recipes and serve with any of the vegetable purées or garnishes which are served with braised ham (see p. 108).

THE SALTING OF HAMS

There are two methods of salting: Dry salting, which consists of a mixture of coarse salt and saltpetre, and salting in liquid brine. The latter is the quicker and more satisfactory, and can be used for beef or tongue or any large joints of meat beside hams. For salting a piece of meat weighing $3\frac{1}{2}$ lbs., the following proportions of brine should be used: Two quarts of water, $\frac{3}{4}$ lb. of bay salt, $2\frac{1}{4}$ ozs. of saltpetre, 4 to 5 ozs. of brown moist sugar, 5 or 6 peppercorns, 5 juniper berries, 2 or 3 sprigs of parsley, $\frac{1}{2}$ bayleaf.

Put all the ingredients in a large saucepan, bring to the boil gradually, and skim. Boil for 5 minutes. Remove from the fire and stand till quite cold. Prick the meat all over with a skewer, somewhat deeply, so that the brine may penetrate it—in the case of large joints, a special implement is used to pump the brine into the meat—then rub it all over thoroughly with bay salt and a little saltpetre, in the proportion of 3 ozs. of bay salt to 1 of saltpetre for the weight mentioned above. Put the meat in an earthenware vessel in which it just fits. Cover with the brine, and keep in a cool dry place. Turn the meat every 2 or 3 days, using wooden spoons and not the hands, as this is apt to alter the

brine. A piece of meat weighing $4\frac{1}{2}$ lbs. should be left to soak for 8 or 9 days in winter and about 6 in summer. A tongue takes from 12 to 15 days when the weather is mild, 15 to 18 days in cold weather, and 8 to 10 days in hot weather. The brine should be boiled for 2 or 3 minutes every 8 days in cold weather, and every 4 or 5 days in hot weather. This is done by pouring the brine into a saucepan, without disturbing the meat, and bringing it to the boil. When quite cold, it is poured over the meat. Should there not be sufficient brine to cover the meat completely, more should be made, in the same proportions, and added when cold. For dry salting, allow about $1\frac{1}{2}$ lbs. of bay salt to $2\frac{1}{2}$ ozs. of saltpetre for $3\frac{1}{2}$ lbs. of meat. Mix the pulverized saltpetre with the salt, 10 peppercorns, 2 sprigs of thyme and a bayleaf. Prick the meat all over with a skewer and rub thoroughly with the salt mixture. Sprinkle a dish freely with the salt and saltpetre, lay the meat on it, sprinkle freely with more salt and saltpetre, the peppercorns, thyme and bayleaf, and keep in a cool and very dry place, turning every 2 days with wooden spoons. The time required for salting is the same as that with the liquid brine. More salt and saltpetre may be added, as the meat should always be well covered. The following are special pickles.

A BEER PICKLE

The ham should be lightly salted for 2 weeks and then placed in the following pickle for a month: 1 quart of old beer, 4 lbs. of brown sugar, 1 lb. of common salt, 2 ozs. of bay salt, 2 ozs. of saltpetre, 2 ozs. of peppercorns, 2 ozs. of black pepper, and 2 ozs. of juniper berries. Boil the pickle for 20 minutes and, when quite cold, pour it over the ham. Dry and smoke in a stove or chimney or wood fire.

A CIDER PICKLE

Salt the ham, put between 2 boards with a heavy weight on the top board, and let stand for 48 hours. Wipe the ham and put in the following pickle for a month : 1 quart of strong cider, 1 lb. of common salt and bay salt, 4 ozs. of saltpetre, 2 lbs. of brown sugar, $\frac{1}{4}$ lb. of crushed juniper berries, 2 ozs. of salt prunella, 2 bayleaves, a few sprigs of thyme, marjoram, tarragon, rosemary and sweet basil, 20 peppercorns, and $\frac{1}{2}$ teaspoon of allspice. Dry and smoke.

A TREACLE PICKLE

One pint of strong beer or cider, $\frac{1}{2}$ lb. of treacle, $1\frac{1}{2}$ ozs. of crushed juniper berries, 2 ozs. of allspice, 1 oz. of peppercorns, $\frac{1}{2}$ oz. of black pepper. Boil $\frac{1}{2}$ pint of the beer or cider, with the spices, and mix the treacle, previously warmed till it liquifies, with the other $\frac{1}{2}$ pint of unboiled beer, and then with the strained boiled beer or cider. When quite cold, pour over the ham, which should have been salted as in preceding recipe. Dry and smoke.

GAMMON

All the recipes applicable to ham can be applied to gammon.

PICKLED PORK

This is soaked for a few hours in cold water and boiled in the same way as ham (see p. 105) allowing 25 minutes to the lb.

PICKLED PORK WITH LENTILS

Put $1\frac{1}{2}$ lbs. of pickled pork in a saucepan, cover with cold water, bring to the boil and remove the pickled pork from

the water. Put the meat in a saucepan and brown lightly in a little lard, with 12 small onions. Then add 1 lb. of lentils, previously soaked in cold water, 1 halved carrot, a stick of celery, a bouquet of mixed herbs, season with pepper and cover with boiling water. Bring to the boil, cover, and simmer for 2 hours. To serve, put the meat on a hot dish and cook the lentils rapidly till the water in which they were cooked is reduced almost completely. Remove the carrot, the celery and herb bouquet, put the lentils on a hot dish, with a few pats of butter, and over this place the pickled pork.

SAUCE SECTION

APPLE SAUCE

Ingredients : 2 lbs. of apples, 3 ozs. of sugar, 2 ozs. of butter, 2 tablespoons of water.

Method : Peel, core and slice the apples, and put them in a thick saucepan with the other ingredients. Bring to the boil and simmer very gently for $1\frac{1}{2}$ to 2 hours, till reduced to a pulp, stirring frequently. If too thick, a little more butter can be added.

BÉARNAISE SAUCE

Ingredients : 3 yolks of eggs, 4 tablespoons of white wine, 6 of tarragon vinegar, 1 tablespoon of finely chopped shallots, 2 level tablespoons of fresh tarragon, 1 of chervil, a pinch of mignonette pepper, salt, cayenne, $\frac{1}{2}$ lb. of butter.

Method : Put the wine and vinegar in a saucepan with the chopped shallot, the tarragon, chervil, and season with the mignonette pepper and a little salt. Bring to the boil and simmer till reduced by two-thirds. Remove from the fire, and when lukewarm, add the yolks of eggs, stirring well, replace on a very slow fire—or put the saucepan in another saucepan of boiling water—and very gradually add the

butter, divided in small pieces, beating incessantly with an egg whisk. When all the butter has been used, the sauce should be very light. It should immediately be strained through a conical sieve, replaced on a very slow fire, and a little chopped tarragon and chervil added, and a dash of cayenne. This sauce should never be allowed to get very hot. It should be treated as a "butter mayonnaise" worked as such, and served lukewarm, otherwise it will curdle.

BÉCHAMEL SAUCE

Ingredients : For about 1 pint of sauce—1½ ozs. of onions, 1½ ozs. of carrots, 1½ ozs. of lean cooked ham, 2½ ozs. of butter, 1½ ozs. of flour, 1½ pints of veal stock or milk, 2 or 3 sprigs of parsley, 1 or 2 of thyme, a bayleaf, salt and pepper.

Method : Cut the vegetables and ham in small dice, put into a thick saucepan with 1 oz. of butter, and simmer for 12 to 15 minutes, but without browning. Melt the remaining butter in a saucepan and add the flour, stirring continuously over a slow fire. Then add the boiling stock or milk gradually, without ceasing to stir. Drain the vegetables and ham thoroughly, add to the sauce with the herbs, and season with salt and pepper. Do not cover the saucepan. Bring to the boil, and simmer very gently for ¾ to 1 hour. When done, strain through a wire sieve into a small saucepan, add a small piece of butter and the sauce is ready for use.

The sauce can be made without the addition of ham.

BORDELAISE SAUCE

Ingredients : ¾ pint of Espagnole sauce (see p. 116), 1½ ozs. of finely chopped shallots (or onion), 1 gill of claret, a little thyme, a small bayleaf, 2 tablespoons of beef marrow (optional), 1 oz. of butter.

Method : Put the chopped shallots and herbs in a small saucepan with the claret and simmer till reduced by half. Add the hot Espagnole sauce, mixing well, and finally the small pieces of marrow, previously poached for 10 minutes in a little water, when the saucepan is taken off the fire, add the butter, also divided into small pieces.

CHASSEUR SAUCE

Ingredients : 1 oz. of butter, $\frac{1}{2}$ oz. of flour, pint of stock, 1 $\frac{1}{2}$ tablespoons of tomato purée or sauce, 4 medium-sized mushrooms, 2 shallots, 6 tablespoons of white wine, 1 teaspoon of tarragon, and 1 of chervil, parsley, salt and pepper.

Method : Put $\frac{1}{2}$ oz. of butter in a saucepan, and when melted add the flour. Stir till brown, and add gradually just under 1 pint of hot stock. Stir in 1 $\frac{1}{2}$ tablespoons of very thick tomato purée or sauce, season with salt and pepper, and simmer for 10 or 12 minutes, without covering the saucepan. Meanwhile, chop the mushrooms and cook them in a little oil till lightly browned, add the chopped shallots and cook for 2 or 3 minutes. Drain off the oil, add the white wine and let reduce by half. Now pour the prepared sauce over the chopped mushrooms, stir well, and simmer for 6 or 7 minutes more. Just before serving, add the tarragon and chervil and the rest of the butter in small pieces, and when the sauce is poured over the meat, sprinkle with a little chopped parsley.

COLBERT SAUCE

Make a Maître d'Hôtel butter (see p. 123) and add to it, when melted, a tablespoon of melted meat glaze and $\frac{1}{4}$ teaspoon of chopped tarragon.

DUXELLES SAUCE

Ingredients : 1 dessertspoon each of chopped onion and shallots, 3 ozs. of mushrooms, 6 tablespoons of white wine, 1 pint of good stock, 1 tablespoon of tomato purée, butter, olive oil, $\frac{1}{2}$ oz. of flour, parsley, salt, pepper and nutmeg.

Method : Put 2 tablespoons of oil and 1 teaspoon of butter in a small thick saucepan. When hot, add the onion and shallot, and cook to a light golden colour, but without browning. Now add the finely chopped mushrooms, season with a little salt, pepper and nutmeg. Stir for 5 to 8 minutes, add the wine, the stock and the tomato purée, and thicken with $\frac{1}{2}$ oz. of butter worked with the $\frac{1}{2}$ oz. of flour. Stir, and then simmer gently for 15 to 20 minutes. Just before serving, add 1 oz. of butter, divided in small pieces, and 1 teaspoon of chopped parsley.

ESPAGNOLE OR BROWN SAUCE

Ingredients : To make 1 quart— $1\frac{1}{2}$ quarts of stock, 1 gill of white wine, 3 tablespoons of tomato purée, $3\frac{1}{2}$ ozs. of lean bacon, $3\frac{1}{2}$ ozs. of carrots, $3\frac{1}{2}$ ozs. of onions, 3 or 4 sprigs of parsley, $1\frac{1}{2}$ ozs. of mushrooms or mushroom peelings, a sprig of thyme, a small bayleaf, 2 ozs. of flour, $3\frac{1}{2}$ ozs. of butter.

Method : Cut the bacon, vegetables and mushrooms, etc., in small dice. Melt the butter on a slow fire, in a thick saucepan which must be just large enough to hold 2 quarts, and as soon as the butter is hot, put in the bacon, vegetables (except the mushrooms) and the herbs, and cook very slowly till slightly browned. Do not cover the saucepan, and stir the bacon and the vegetables occasionally with a wooden spoon, so that they will be equally browned. Now sprinkle with flour, and mix thoroughly. Let this cook very gently for 15 to 20 minutes till brown. Then add

gradually the wine and stock, stirring continuously. Keep 1 gill of the stock which will be used at a later stage for the skimming of the sauce. Bring to the boil, add the mushrooms or mushroom peelings, as well as the tomato purée, and simmer gently for 1 hour, without the lid. Skim carefully as grease and scum rise to the surface. Now strain the sauce into a clean saucepan through a wire sieve, bring to the boil and simmer. Skim carefully as the grease rises—this sauce should be absolutely free from all grease—adding 1 or 2 tablespoons at a time of the cold stock which has been kept in reserve, and which helps to make the scum rise to the surface. This skimming will take about $\frac{1}{2}$ hour. Strain once more through a sieve, and the sauce is then ready for use.

GRAVY

Either use brown stock or brown a few bones and trimmings from the meat in a little fat in the oven. Remove the bones and meat and put them in a saucepan, diluting the sediment in the pan with a little boiling water and adding to the contents of the saucepan. Cover with hot water, season with salt and pepper, bring to the boil and skim carefully. Simmer for $2\frac{1}{2}$ to 3 hours. Strain through a cloth before using.

HORSERADISH SAUCE

Ingredients : 2 ozs. of finely grated horseradish, 1 tablespoon of vinegar, 6 tablespoons of cream, $\frac{1}{2}$ teaspoon of mustard powder, salt, 1 teaspoon or more of sugar (optional).

Method : Put all the ingredients in a basin, mix thoroughly, and add the cream gradually.

MADEIRA SAUCE

Make $\frac{1}{2}$ pint of Espagnole sauce (see p. 116), remove the

saucepan from the fire and stir in 6 tablespoons of good Madeira, and serve at once. If the wine is added to the sauce while it is still simmering, it is apt to lose its flavour.

MINT SAUCE

Ingredients : For an average-sized sauceboat—4 tablespoons of finely chopped mint, 1 gill of vinegar, 2 tablespoons of sugar.

Method : Wash and pick the mint, dry it in a cloth and chop finely. Put it in the sauceboat and thoroughly mix with the sugar and vinegar.

MORNAY SAUCE

Ingredients : $\frac{1}{2}$ pint of Béchamel sauce (p. 114), 1 oz. of finely grated Gruyère cheese, 1 oz. of finely grated Parmesan cheese, 1 oz. of butter.

Method : Add the finely grated cheese to the hot sauce, and stir over a slow fire till the cheese has melted. Remove from the fire and add the butter, divided in small pieces

OYSTER SAUCE

Ingredients : 1 $\frac{1}{2}$ dozen oysters, 1 oz. of butter, 1 of flour, the oyster liquor, sufficient milk to make a little over $\frac{1}{2}$ pint of sauce, salt and pepper.

Method : Open the oysters carefully, and save their liquor. Put it in a small saucepan with the oysters, bring to the boil and remove immediately from the fire. Cook the flour in the butter blending well but without browning, then add gradually the oyster liquor and warm milk. Season with salt and pepper, and simmer gently, stirring continuously till the sauce shows signs of thickening. Remove from the fire, add a small pat of butter and the oysters. Put back on the fire to warm, but do not let the sauce boil.

PIQUANTE SAUCE

Put 1 gill of white wine and 1 gill of vinegar in a saucepan with 1 tablespoon of chopped shallots and cook till reduced by half. Then add $\frac{1}{2}$ pint of Espagnole sauce (see p. 116) and simmer for 10 minutes. Remove from the fire and add 1 tablespoon of chopped gherkins and a little chopped parsley, chervil and tarragon. Chopped capers are sometimes added to this sauce.

POIVRADE SAUCE

(Pepper Sauce)

Ingredients : 1 small onion, 1 small carrot, 1 teaspoonful of chopped shallot, a sprig of parsley, a sprig of thyme, $\frac{1}{2}$ a bayleaf, 1 tablespoon of oil, 1 gill of wine vinegar, $\frac{1}{2}$ pint of stock, 1 oz. of butter, and 1 oz. of flour, 2 or 3 tablespoons of white wine (optional), salt and peppercorns.

Method : Cut the vegetables into dice and cook them till a light brown in a tablespoon of oil with the seasoning. Then drain off the oil, add the vinegar and wine, and simmer very gently till reduced by half. When thus reduced, add to the hot stock, which has been thickened with the flour cooked in the butter. Simmer gently for about $\frac{3}{4}$ hour. Skim carefully, and 5 minutes before straining the sauce add 10 or 12 freshly and coarsely ground peppercorns. Strain through a cloth and add a small pat of butter before serving.

ROBERT SAUCE

Ingredients : 1 large onion, $\frac{1}{2}$ pint of Espagnole sauce (see p. 116), 4 tablespoons of white wine, butter, 1 teaspoon of mustard, salt, pepper and a pinch of sugar.

Method : Cut the onions evenly into small squares and cook in a little butter till slightly browned. Reduce the

wine to about half the original quantity. Mix the Espagnole sauce with the onions and wine and simmer gently for about 20 minutes. Season with salt, pepper and sugar. Just before serving make the mustard with a little of the sauce and stir it in at the last moment, as the mustard should never be boiled. Serve very hot. This is a very good sauce to serve with boiled beef.

SOUBISE OR ONION SAUCE

Ingredients : 1 lb. of onions, 3 ozs. of butter, 1 pint of Béchamel sauce (see p. 114), 4 tablespoons of cream, salt, pepper and a pinch of sugar.

Method : Peel the onions and chop them finely. Blanch in boiling water for 10 minutes, drain, and simmer in 1 oz. of butter till quite soft, but without browning. Then add the Béchamel sauce, season with salt, pepper and sugar and simmer very gently for about $\frac{1}{2}$ hour. Rub through a sieve, replace the sauce in a saucepan, cook over a slow fire, and when hot add 2 ozs. of butter, divided into small pieces, and 4 tablespoons of cream. The sauce should be creamy and very white.

TOMATO SAUCE

Ingredients : 1 small onion, 1 lb. of tomatoes, a sprig of thyme, parsley, $\frac{1}{2}$ a small bayleaf, 1 tablespoon of olive oil, or $\frac{1}{2}$ tablespoon of butter, salt and pepper.

Method : Put the oil or butter in a saucepan, and when hot add the onion coarsely chopped. Cook to a light golden colour and crush with the back of a wooden spoon, so that the oil or butter are well flavoured. Add the tomatoes, either sliced or quartered, the herbs and salt and pepper. Stir well, crushing the tomatoes so as to extract the juice. Simmer very gently for an hour, or till the tomatoes are

reduced to a pulp. Rub through a sieve and warm up the sauce just before serving.

VELOUTÉ SAUCE

Ingredients : 1 pint of white veal stock, 1 oz. of butter, just under 1 oz. of flour, 2 tablespoons of mushroom liquor, or 1 oz. of mushroom peelings and stalks, 2 or 3 sprigs of parsley, salt and pepper.

Method : Put the butter in a thick saucepan, and when melted add the flour and stir till smooth over a slow fire. Add the stock gradually, beating continuously with a sauce whisk, bring to the boil and skim carefully. Add the mushroom liquor or peelings, the parsley and seasoning. Simmer gently for 1 hour, removing every particle of grease, and strain through a wire sieve.

Stuffings

VEAL STUFFING OR FORCEMEAT (1)

Chop the veal, which should be lean, and pound in a mortar, adding half the quantity of bread panada. Season with salt and pepper, add 2 ozs. of butter, 1 or 2 eggs to bind, and a few tablespoons of cold Béchamel sauce (see p. 114). Rub through a sieve and work with a spoon till quite smooth.

Bread panada is prepared in the following manner : Break the bread in small pieces, put in a soup plate or pie dish, and pour a little boiling milk over it. Sprinkle with a little salt and let it stand for about $\frac{1}{2}$ hour. Then work it into a paste, put it in a saucepan on a quick fire and stir with a wooden spoon until the paste no longer clings to the spoon. Remove from the saucepan and allow it to cool. It is then ready for use.

VEAL STUFFING OR FORCEMEAT (2)

Chop $\frac{1}{2}$ lb. of lean veal and put through the mincer and pound in a mortar with $\frac{1}{2}$ lb. of finely chopped suet and 2 ozs. of fat bacon. Season with 1 teaspoon of finely chopped onion, salt and pepper and mix with 2 tablespoons of breadcrumbs and 2 eggs to bind.

PORK STUFFING (Plain)

Chop equal parts of lean and fat pork, season with salt, pepper and mixed spices, pound in a mortar, bind with eggs, and rub through a sieve.

VEAL AND PORK STUFFING OR FORCEMEAT

To $\frac{1}{2}$ lb. of lean veal and the same of lean pork allow 1 lb. of fat pork or bacon. Chop finely, pound in a mortar, season with salt and pepper, bind with eggs and rub through a sieve.

SAUSAGE MEAT

Put equal parts of lean and fat pork through the mincer with 1 or 2 cloves of garlic, a sprig of thyme, marjoram, sweet basil, rosemary, and season with salt and pepper. Mix with sufficient white breadcrumbs to give it consistency, bind with the necessary number of eggs and cook lightly in a little butter till browned before using as a stuffing.

Compound Butters

ANCHOVY BUTTER

Ingredients : 2 ozs. of butter, 1 oz. of anchovies (in brine), or $1\frac{1}{2}$ teaspoons of Essence of Anchovy, a pinch of salt.

Method : Wash the anchovies thoroughly in cold water, drain and dry them in a cloth. Remove the bones very

carefully and pound the anchovies to a smooth paste in a mortar. Add the butter and pound and mix with the anchovies. Rub through a sieve into a basin and stir with a wooden spoon.

HERB BUTTER

Ingredients : Butter, tarragon, chervil, chives, thyme, marjoram, rosemary, salt and pepper.

Method : Allow 1 teaspoonful of mixed herbs, finely chopped, to each 2 ozs. of butter. Proceed as in the previous recipe.

MAÎTRE D'HÔTEL BUTTER

Ingredients : Butter, chopped parsley, salt, pepper, lemon juice.

Method : Proceed as in the other recipes for compound butters. Allow about 1 small teaspoon of finely chopped parsley to every 2 ozs. of butter.

TOMATO BUTTER

Ingredients : Butter and an equal weight of tomatoes, salt and pepper.

Method : Peel the tomatoes, squeeze in a cloth so as to extract as much moisture as possible, pound in a mortar with the butter, and add a seasoning of salt and pepper.

Sundries

VEGETABLE PURÉES

Vegetable purées are made by boiling the vegetables till tender, draining thoroughly, rubbing through a sieve and

mixing with a little butter, or sometimes milk or cream, and seasoning with salt and pepper.

TOMATO PULP

Put the tomatoes, sliced or quartered, in a thick saucepan with no other ingredients or liquid, and cook for 1 to 1½ hours, stirring and crushing with a wooden spoon occasionally, till reduced to a pulp. Rub through a sieve. This will keep for several days in a cool place.

HOW TO LARD

The process of larding consists in inserting small strips of larding bacon into the meat with the intention of making it tastier and more juicy. Lean meat is especially improved by larding. There are two kinds of larding: that which is just superficial and where the lardoon is inserted or, as it were, "sewn" on the surface of the meat; and the other, or "deep" larding, where the lardoon is inserted through the whole thickness of the meat. For both these processes larding needles are required. For superficial larding the bacon fat should be cut in thin equal strips 1½ inches in length and about ¼ inch thick. Insert the larding needle in the meat as if sewing, taking a stitch of about ½ inch, and draw it three-quarters out. Now put the lardoon in the larding needle and carefully draw out the needle, leaving the lardoon in the meat with the two ends showing. The larding should be done in regular rows.

For deep larding a larger needle is required. Insert the needle through the meat, then put in the lardoon and draw the needle out, leaving the lardoon in the meat with the ends just showing on either side. The length of the lardoons must vary according to the thickness of the meat.

being to bring the wheel into contact with the work, and feed it towards the work automatically, a definite amount at each stroke of the table. An ample flow of water should be provided for heavy cutting on large pieces, and to assist this the vertical spindle of the machine is hollow, and arranged to act as the feed-pipe for the water. A junction in the

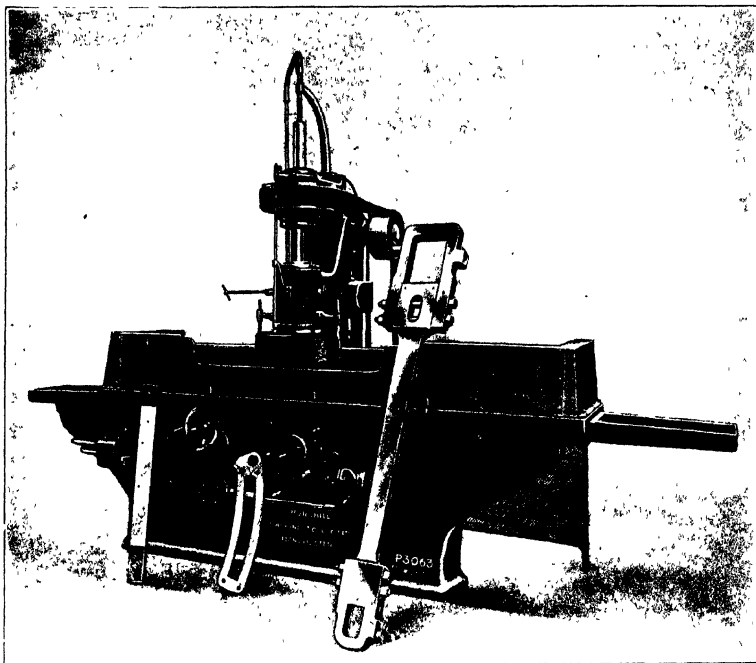


FIG 4.—VERTICAL SPINDLE FLAT SURFACE GRINDING MACHINE BY THE CHURCHILL MACHINE TOOL Co., LTD

pipe permits the water to be run on to the outside of the wheel if required, this jet being also useful for cleaning the chuck and the table.

The grinding of the motion-links requires the use of a radius rod, otherwise this work can be performed on machines used in general for internal work. A machine is available which combines in itself capacity for internal cylindrical grinding up to 12 in. diameter and 24 in. in length, flat surface grinding up to 18 in. wide and 30 in. long, and link

grinding up to 24 in. length of slot between a range of 42 and 84 in. link radius. In Fig. 5 is shown a link in grinding position on this machine, as fixed to the chuck which is attached to the end of the pendulum of adjustable swing. The column holding this pendulum can be swung clear of the main working table when the machine is required to operate on cylindrical or flat surfaces.

Two further machines of interest—both highly specialized—are (1) the journal trueing grinder, and (2) the crankpin grinding and quartering machine. The first has been constructed with a view to the

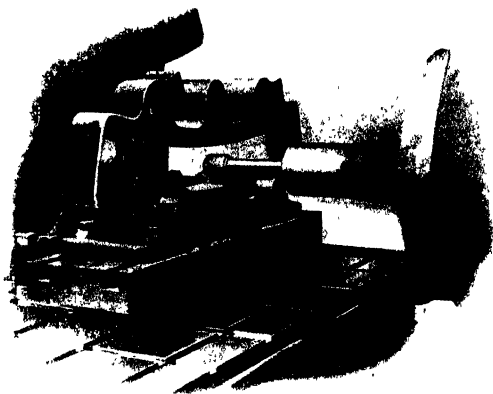


FIG. 5.—LINK IN GRINDING POSITION ON MACHINE

economic surfacing of worn axle journals, in which process grinding has the great advantage of removing only the minimum amount of metal which is necessary for the provision of a new and perfect running surface. The second machine provides a striking example of the progress in finish of locomotive work, which has led to the demand for its development. This grinder has two headstocks with slides at right angles, and each is provided with independent drive. The range of throw of crankpin which can be ground is equal to 22-in. to 30-in. stroke, thus covering all dimensions usual in this country. The extreme length ground is 15 in., and the maximum diameter of pin which can be taken is 7 in. In addition to the pin-grinding, the machine can also be used for finishing the holes in the driving wheel.

To secure the utmost reliability for all Material used in Locomotive Construction.

It is usually thought necessary to have the constant check of chemical analysis in addition to stringent mechanical test. The pig-iron, coke, and various other materials for the iron foundry are all subjected to analysis, the results of which permit the selection of the best material for each purpose, and enable the locomotive engineer scientifically to blend two or more varieties of metal so as to obtain a good cast-iron, when the use of either variety alone would result in an unsatisfactory casting, owing to the excessive proportions of some deleterious constituent, such as sulphur, silicon or phosphorus.

The analysis of copper plates for fire-boxes, copper and bronze bars for fire-box stays, and copper tubes for the locomotive boiler is another important branch of the chemist's work; small quantities of impurities in these materials have an important effect, both for good and evil, upon the life and efficiency of the boiler into the construction of which they may enter; for instance, in fire-box plates a certain small quantity of the metal arsenic is said to be distinctly advantageous, while more than this proportion is, without doubt, most objectionable.

The materials for the bearing-brasses and bronzes are also closely examined to determine their purity in order that no irregularity of composition may be experienced in the finished castings; alloys for metallic packing and the so-called frictionless metals pass through the chemist's hands to prove that they possess the requisite qualities for the purposes to which they have to be applied and to ensure that their value, as judged from their chemical composition, is proportionate to their price, which is by no means invariably the case with proprietary articles.

The materials for painting are supplied to stringent specifications, and it is most important that the supplies should conform to them if the locomotives are to present a uniform appearance as regards colour, and resist the ravages of weather, smoke, and wear.

After the locomotive has commenced running, the chemist will by no means have severed his connection with it. His business is now to closely watch the composition and quality of the various materials necessary for its maintenance and well-being; for instance, the water with which its boiler is to be fed, the coal with which that water is to be converted into steam, and the oil with which its cylinders and motion are to be lubricated. These and the many other things required for the running-department are all subject to the chemist's scrutiny.

If the water contains more than a certain proportion of chalky matter, which would deposit upon the tubes and fire-box plates so as greatly to reduce their efficiency as conductors of heat from the furnace to the water, then the chemist will advise the substitution of another source of the boiler feed-water which shall not possess this objectionable feature; or he may be called upon to suggest a method of chemical treatment to remove the cause of trouble from the water before entry into the boiler. Again, if he finds the water to contain even small quantities of an apparently harmless substance—nitrate of soda—it will be his duty to advise that the use of the water be discontinued for locomotive purposes, because its presence in conjunction with the small quantity of common salt which exists in almost every natural water, is likely to cause serious corrosion in a double metal boiler at the points of contact between copper and steel when the water becomes concentrated after continued steaming.

The coal will be examined by combustion in a suitable calorimeter to estimate its comparative heat-giving qualities, and the composition and quality of its ash will be determined. If the coal contains much ash which is fusible or liable to decompose into fusible substances (for instance, iron pyrites), it is likely to give rise to the troublesome formation so well known to locomotive and naval engineers, under the name of "swallow's-nest," on the tube ends in the fire-box; this formation may choke the tubes—particularly if the coal be friable or dusty—and prevent the boiler from steaming satisfactorily and responding to the heavy demands which long-distance runs with heavy loads make upon the modern locomotive.

The examination of oils for the lubrication of the locomotive is a most important branch of the chemist's duty; the number of proprietary oils offered for each purpose is very great; the chemist enables an engineer to choose between them when it would be impossible to carry out satisfactory practical trials on a locomotive, and by acquainting him with the nature and proportions of their constituents places him in a position to judge better as to whether he gets value for money, etc.

Colour Controls for Machine Tools.

A novel method of securing accuracy in the operation of machine tools in Colonial workshops, where skilled labour is of a somewhat primitive type, has been developed in the workshops of the Soudan Government Railways, and deserves mention in these pages.

The necessary gauges for the valve-gear maintenance of the Soudanese locomotives involved nominal sizes from $1\frac{1}{2}$ in. to $2\frac{1}{8}$ in.

diameter. These sizes are the group sizes, and are indicated by a coloured and figured disc above each cabinet, plainly visible in the picture reproduced (Fig. 6). The complete group against any one nominal diameter necessitates four cabinets, arranged in plan round a hollow square. The gauge sizes advance in steps, and the gauges included under the one nominal diameter provide a complete set,



FIG. 6—COLOUR GAUGE CABINETS.

which finish at the commencement of the next $\frac{1}{8}$ in. of nominal dimension. One very important aspect appears with this subdivision of cabinets into Series 1-2-3-4. Series 1, of course, commences with the nominal size, the last gauge of Series 4 being the largest size to the nominal diameter. In the photograph (Fig. 7) will be seen a step gauge, of the dimensions of the plug gauges. The motion examiner uses this step gauge for checking the worn holes, and if the second Series step gauge drops through to the extreme, it is taken as an indication that the case-hardening of the part has worn away, and that it must be rehardened. If the step gauge of Series 4 drops through the worn hole, the part is scrapped.

By reference to the photograph (Fig. 7) it will be seen that there are five horizontal ranks of gauges. These are as follows:

- Top Row—Plug gauge "go" and "not go" for fixing fits.
- 2nd Row—Plug gauge "go" and "not go" for running fits.
- 3rd Row—Calliper gauges "go" and "not go" for both fits.
- 4th Row—Checking blocks for the calliper gauges.
- 5th Row—Approach discs.

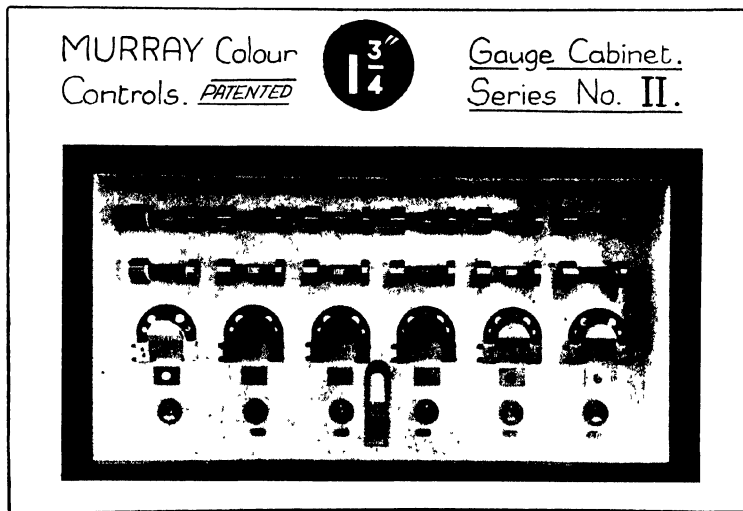


FIG. 7.

The first four rows contain well-known gauges, but the last collection of "approach discs" needs an explanation. These discs are all 0.003 in. over the calliper gauge size, and when the calliper gauge is issued a disc is issued with it. This disc is rapidly fastened to the grinding machine by a screwed spindle, and is used as a gauge by the operator to grind his work, by setting his callipers to the disc. This obviates the necessity of his using the calliper gauge on a running surface, which is relatively large to the finished diameter. When the work is ground down to the "approach disc" size the machine must then be stopped for verification with the standard calliper gauge.

The whole of these gauges and discs are provided with colour markings. For example, the group colour of $1\frac{3}{4}$ in. is yellow, and

this is the basis colour for all gauges of this group. The step gauge has each panel coloured. Each gauge of the series has the colour corresponding to the step, and then a further colour corresponding to the series. For instance, the plug gauge, "B," has the knurled shank yellow, the grooves adjacent to the heads blue, and the two smaller grooves red.

This indicates that it (yellow) belongs to the $1\frac{3}{4}$ in. group (two red bands) of the third series, and (blue bands next to the gauge diameters) of the third step. The same principle has been carried throughout the whole of the valve-gear diameters $1\frac{1}{2}$ in. to $2\frac{1}{8}$ in., with the most gratifying results so far as this particular item of locomotive equipment is concerned. It is surprising how few colours are required to cover all the necessities of the system, and for the most part primary colours only are employed.

CHAPTER XV

The Enginemen—Training—Engine Preparation—Foremen's Experience—Signals—Running—Automatic Stops, etc.

Training of an Engineman.

The usual training of a locomotive driver commences with a probationary period in the shed as a cleaner; from this promotion is made to the post of a fireman. The preliminary term should give the expectant engineman a good knowledge of the working parts of a locomotive, and it is during his service as a fireman that he will become better acquainted with the operation of the many details he has seen. It is to the advantage of all that a fireman should be well versed with the working, as there is no doubt that a man well skilled in the operation of the details of the machine allotted to his care will prove more efficient; a careful and capable engineman mounts a footplate with confidence and maintains a cool nerve under, often, very difficult circumstances, whereas a careless, inexperienced man, if called unexpectedly on a trip that requires attention and care a little above the normal, will frequently fail through nervous fear of something going wrong, and when called upon to think and act in an emergency often lacks decision and gets into trouble.

A fireman's duties needs both brain and muscle, and on the majority of trains—passenger or goods—an engine always has to be kept working near the limit of its powers, for unless the "needle" of the steam-gauge is kept well over to the working pressure figure, time must be lost. Experience alone is the best teacher for a fireman; from it he gets to know how to obtain the best results from his engine. It is difficult to lay down hard-and-fast rules as to the best methods of firing, when there is so much difference in the quality of the coal used, and also in the manner in which different engines consume their fuel. One locomotive will burn more from the front of the box, whilst another appears to consume it more rapidly from the back corners of the grate, or along the sides; there are innumerable differences in the "liking" of any particular locomotive which an observant fireman does not fail to take note of.

The usual commencement of an engineman's career is cleaning, then firing on a shunting-engine, but circumstances often arise in which a young and inexperienced hand is sent out with a driver on a train of more or less importance. Say, for instance, on a fast and heavy goods train; the driver has very little time to instruct the novice, with signals to watch, comparatively small power available, slack couplings, and the knowledge that if he gets behind time he will very probably delay a passenger train—altogether not an enviable position to be in.

Before starting, the driver will no doubt see that the fire is in good condition and that there is plenty of water in the boiler, and will also give the new hand hints as to the kind of fire with which the engine steams best; in the circumstances this is the utmost the driver can be expected to do. With a good start, steam will probably be maintained for a considerable distance, if the engine is a free-steaming one and the coal of reasonable quality; but the young fireman, not accustomed to fast running on a footplate, finds it difficult to place the fuel just where it is required. This is no easy feat on locomotives with the long fire-boxes now in vogue; consequently, the fire gets dirtier than it would if stoked in a proper manner, and by the time half the journey is completed the steam pressure drops below the required point. If, in addition, the engine is a poor one to steam under good conditions, or the coal of indifferent quality, the position of the driver is not to be envied.

Among drivers the remark is frequently heard that they have had "mates" who did not know how to start the injectors, or the whereabouts of the blower handle. This is not always the fault of the young fireman, for in some sheds, with good reason, the cleaners are forbidden to touch anything on the footplate.

A good plan in the case of the cleaner is to put him to work with the "fire-lighter" or steam-raiser for a time, to get used to handling the shovel and starting the injectors; of the latter, on some lines, there are various patterns needing different ways of operating. Other items are usually picked up in the shed.

As regards the fireman, a short instruction by a qualified man on the theory and practical working of the various parts of the locomotive and brake apparatus, in a school equipped with models and drawings, greatly stimulates the men's interest in their work, and will certainly be of use to them, as has already been remarked, for when a man properly understands his machine he is better able to manage it.

There is no difficulty about describing the mechanical details of an engine and giving valuable information on the best-known methods of

dealing with them. For example, this is admirably done in *The Locomotive of To-day*, but the actual handling of the engine on the road is quite a different matter. Ask any driver how he can judge where to shut off steam and where to apply the brakes so as to stop at the right place at any given station, under varied conditions of weather, load, etc. In all probability he will look at you with a bewildered air, and reply, "I don't know," notwithstanding the fact that he has done it himself for twenty years, or more, without a single failure. He will brighten up at once, however, when he thinks of an alternative, and invite you to go and see for yourself how he does it. He cannot tell you, but he can show you, and unless you have had considerable experience on the footplate you will be just as wise after the demonstration as you were before it.

Few people realize how lonely a driver must often feel when on the road. He stands for hours looking through the window of the cab, whilst signal after signal passes across his vision, and he must, without fail, detect out of hundreds the one which appertains to his train, differing only in position or colour from all the rest. Should he not obey *that one* the probability is that in a very short time the whole country will be apprised of his mistakes by the proclamation of newspaper notices.

Seldom does a word pass between driver and fireman when running unless something unusual happens, and even then it is only what is absolutely necessary that is spoken. Apart from the noise in the cab—which makes conversation difficult—each has his duties to attend, and these take up his whole attention. The fireman is so occupied attending the fire, water, and lubrication that he has no time for anything else except to assist in the look-out for signals as much as he can. Any neglect on the part of the fireman, or an error in judgment in firing may land the driver in difficulties for steam supply. The driver's anxiety on this score is well seen by the frequency with which he steals a glance at the water and pressure gauges; in fact, he hardly ever takes his eyes off the look-out window for any other purpose.

An experienced driver actually feels as if he were a part of the complete machine; he can almost instantly detect anything unusual. He can smell a hot bearing and feel the breakage or displacement of any part, even if it should not be so serious as to cause him to stop. When anything of the kind does unfortunately happen, the driver's anxiety is seriously increased. His business is to land his train safely, and, if possible, on time; the loss of one minute is recorded against him, and he must be prepared to account for it. Any trivial excuse will not be accepted as justifying loss of time, and he knows it. On that account

slowing down or stopping are the very last things he thinks about, and after all the responsibility rests with him; he has no time for consultation, even if a consultant were available; he must act at once.

Enginemen will generally face any kind of weather without concern, with one exception. Ask any driver what tries his nerves most, and without hesitation he will answer in monosyllable—"Fog." During fog he has scarcely anything to guide him except ghostly shadows of signals, and these he must sometimes count as he goes along. If he loses his reckoning he is in great suspense till he passes some familiar landmark, such as a bridge, cutting, station, or something which he can recognize from sound. Sometimes for hours he has to stand with his face projecting past the side of the cab, straining his eyes till they ache, in the vain attempt to pierce the impenetrable fog. In such conditions, is it surprising if he utters a word of thankfulness on reaching the end of his journey in safety?

The colours, position of arms, and a few other points are well and clearly defined. All signalling is carried out on certain general principles, but the peculiarities of different junctions and crossings cause these general methods to be modified so frequently that few standing rules can be framed for precise guidance on all occasions.

Locking and interlocking of points and signals are so thoroughly carried out now that the risk of mistake by a signalman has been reduced to a minimum. In fact, about the only mistake he can now make is that of allowing one train to follow another before the section is clear.

Many attempts have been made to invent a reliable mechanical system by means of which a train can be stopped in the case of a driver passing a signal at danger. Several of these have proved sufficiently reliable and successful to induce railways to apply them. An example can be found in a simple and effective apparatus used on the London Underground Railways, which is known as the automatic train-stop, to stop any train which may attempt to pass a signal when in the "danger" position. To secure this result both signal and brake apparatus must co-operate, and there is fitted on every train what is known as a "trip" valve. This, in its simplest form, comprises a cock with a handle hanging vertically, the cock being closed whilst the handle is in this position. If the cock is opened it allows air to escape from the brake-pipe, and thus applies the brake. This trip-valve, as well as a complete equipment of "quick-acting" brake apparatus with slack adjuster, and the driver's brake valve, are fitted on the coach—generally known as a "driving trailer"; if required, air relays can be used for cutting off the supply of power to the motors.

Fixed to the track, there is located at each signal a "trip" arm. In the normal or "clear" position of the signal, this arm lies horizontally below the track, but assumes a vertical position when the signal goes to the danger and thus intercepts the handle of the trip-valve of any train attempting to pass it, opening the cock and applying the brakes, etc., as described.

As it is extremely important that the trip-arm shall assume the vertical position, and be in a place ready to stop any train which may attempt to pass a signal at "danger," a contact box is connected to the arm. A circuit is taken through this contact box and so coupled as to ensure that the next signal in the rear cannot be cleared until the train-stop protecting the signal, which has just been passed by a train, has risen to "danger."

In order to become a first-class driver a man must almost live on the engine, till he becomes like a part of it, and he must run over the line till he knows it so well that he could tell where he is and at what speed he is running at any moment, even if blindfolded. This is actually the condition in which some men are to-day; they are familiar with every yard of the road, with signals, loops, and junctions.

Engine Preparation.

Before going underneath, place the engine in mid-gear, open the drain-cocks and put the brake hard on. Any recesses in oil reservoir caps should be wiped clean before removing the cane or cork, as otherwise any accumulated dirt will be washed into the cup with the oil and give trouble subsequently, especially in those cases where wire trimmings are employed. If at all doubtful, canes should be tested for porosity by blowing through them, and changed if necessary. The consumption of the individual bearings should be watched. If syphoning too much, the number of strands of worsted (where used) must be increased; conversely, a reduction in the number of strands increases the flow of oil. With wire trimmings the flow of oil is reduced by using wire of heavier gauge, and vice versa. Oil-cup and lubricator covers must be replaced securely subsequent to feeding, and should be spanner-tight; if left loose, the cover will work off, oil will be thrown out and the bearing concerned will heat.

Although too much importance cannot be attached to the attention given to the lubrication of major bearings—e.g. big-ends and boxes, there are others which, although occasionally overlooked, should never be neglected. Random examples are motion-pins, spring-pins, and bogie centre pins; regular oiling of all horn-blocks is also absolutely

essential, and in the great majority of modern engines definite provision is made for this. Before feeding the axle-boxes the driver must satisfy himself that there is no water in the oil reservoir; bogie-boxes in the vicinity of the cylinders are especially susceptible, and a syringe is indispensable in this connection. The trimmings must be removed, squeezed and cleaned, and a small quantity of oil fed directly to the stand-pipe; incidentally, trimmings in general and also oil-ways should be examined at regular intervals for cleanliness. Piston-rod mops must also be examined for cleanliness and, further, to see that there are no straggling ends; the latter conduct the lubricant to the permanent way, where it is not required, in a most efficient manner.

Hydrostatic lubricators, the reservoirs of which must be blown out with steam at least once weekly, should be started ten minutes before leaving the shed.

The general tendency is to over-oil an engine. It must be remembered that the whole object of lubrication is attained when a thin film of oil is established, this film preventing metallic contact between the journal and its bearing. It is surprising how little oil is required for this purpose, and any quantity supplied in excess of this amount is merely wasted. The state of the permanent way on which an engine has been standing is an infallible indication of the manner in which it has been prepared. The only time when an engine should be lavishly oiled is when it is fresh from shops.

Both injectors, or other boiler-feeding apparatus, must be started before leaving the shed to prove that they are in proper working order; in very few cases is there any excuse for an engine giving up its train owing to the failure of both injectors. Brakes must also be tested (with the vacuum-brake, the small ejector must be started with the driver's handle in the "full-on" position, in order to prevent the emission of condensate at the chimney) and the water-gauges blown through, special attention being given to the cleanliness of their glasses, reflectors, and guards.

There are two things which the fireman must never take for granted—namely, the cleanliness of the ash-pan or the smoke-box. He must also satisfy himself that the tube ends are clean and that the smoke-box door is tightly closed. The coal on the tender must be so trimmed that there is no danger of any falling off during the trip, and all large lumps should be broken up. The fireman must also see that the engine leaves the shed with a full tender of water and sand-boxes filled. All lamps must be trimmed and cleaned; the cab must also be cleaned, the plate work being rubbed down with a cloth and a small quantity of cylinder

oil. The boiler face-plate mountings should be burnished; the moral effect of a clean "front" cannot be overestimated.

When semi-bituminous coal is the fuel used, a bucketful of stones or broken firebrick spread over the grate will prevent the fire "running" on the bars. Excessive use of the blower jet when steam is being raised should be avoided, as a fire unduly forced in the shed may give trouble on the road by clinkering up, and in addition, the too rapid generation of heat in the fire-box may start tube ends and stays leaking.

The Running-shed Foreman.

It has been said that to secure success in the railway service a man should look at things generally in a big way, be broadminded and not too fastidious over details. He should be in a position to understand the working of all departments, making a speciality of his own whilst being a keen observer of character and able to select the right men to assist him. The remarks apply very directly to candidates for the post mentioned above: a good running-shed foreman is an invaluable help to the locomotive department. He is responsible for the satisfactory operation of the engines in the district under his charge, and is expected to possess first-hand knowledge of the staff he controls, keeping in close touch with the working details and running requirements of his section. Heavy traffic will make conditions more difficult to arrange for the care and maintenance of engines between trips and also organize the employment of staff. It is essential that a shed foreman should know how to meet a difficult mechanical problem as well as settle in a diplomatic manner irritating differences among the staff. With the increasing size of locomotives, their long runs and quick turn about, it is necessary that efficient assistance should be rendered the foreman so that he can better devote his time to the larger and more important calls for his attention. It is a more paying proposition to the railway for him to look after the working demands of traffic and power than for him to waste time on slips of paper and pieces of scrap.

The conditions to be filled by a shed foreman have been outlined as follows:

He must be neither too young nor too old. Have a good education and a thorough knowledge of handling and repairing locomotives; able to form an estimate of time required for a job, and know how to handle men successfully. Be of a diplomatic temperament to keep on good terms with the traffic staff—in other words, of a cheerful disposition. Have no objection to be on duty on holidays or nights. Have a good constitution, able to withstand adverse weather conditions, wind, rain,

frost and snow. Have a clean and tidy conscience, for there is no better indication of an efficient chief of a running-shed than the appearance of its interior; cleanliness is most telling. In a well-appointed shed the pits are kept clean and all refuse, scrap, bolts, etc., removed. In the daily routine of duty all working parts of the engines are examined after each trip and necessary attention given to details requiring it, records inspected, etc.

The maintenance of the boiler and fire-box is a foremost consideration; boilers should be kept clean by frequent and thorough washings out. With modern hot washing-out plants the time is materially decreased. Sufficient pressure should be used to ensure the jets reaching all the corners of a fire-box and every use made of all the plugs provided, especially with the rakes in those situated around the foundation ring. Where water treatment is in use this work is much simplified.

An inspection of the fire-tubes and superheater flues should be made after each trip, and when leaks are detected they should be caulked. Fire-box leaks, if they do not always cause engine failures, waste fuel. The fire-box and its grate should be kept to a recognized standard of cleanliness and efficiency.

Frequent examinations of the smoke-box is important, and when reports are received of bad steaming, etc., a careful examination of steam-joints in the smoke-box, as well as any possible air leaks, should be made before drastic action to any of the details of the chimney or the blast-pipe is undertaken.

The valve-gear, of course, is of vital importance; any development of play at joints, etc., of the motion should be corrected; similarly, any leakage of valves, pistons, etc., must have attention. In other words, "a stitch in time saves nine" will prove of paramount advantage in keeping locomotives at work.

If there is one detail on a locomotive which causes more irritation to an engineman than another it is a defective feed-injector. When one refuses to work it is not at all uncommon for the second to refuse to operate until a lot of time has been lost in coaxing it.

The brick arch is a very useful adjunct to a locomotive's good steaming, especially in districts using "black" or "soft" coal; rebuilding will often repay itself rather than allow an engine to be taken out for a long run with half an arch.

All steam-leaks round a locomotive are much to be deprecated by a good shed foreman. Nothing looks worse than to see a fine engine standing enveloped in a fog from small leaks of steam from fittings.

There are many degrees in the good firing-up of locomotives in a steam-shed—good, bad, indifferent. A good lighter-up will so build

his fire and regulate dampers that steam will begin to show within two or three minutes of his estimate—then, by opening the blower and touching-up his fire, it will make steam to 120 lbs. with scarcely any smoke, ready for the driver's appearance at the booked time. An indifferent operator will "blow-up" the fire, send the gauge up to "popping" off, and then have to fill the boiler up with water to keep it quiet. When the driver arrives, mounts the footplate and opens the regulator, he deluges everybody with water. A locomotive should stand ready for its crew with just enough fire to keep the steam within 20 lbs. of "popping," so that the fireman can build up his own fire to requirements. A shed foreman should take note of any careless raising of steam and insist on careful lighting up and attention to fires started.

Cylinder cocks should be kept open during all initial movements of the engine, as condensed steam is certain to be present in pipes, ports and cylinders after a long interval of standing.

On arrival at the shed for duty, it should only be necessary for the driver and fireman to secure their immediate wants and stores prior to the engine's departure.

Smoke is often a source of complaint from residents in the locality of running-sheds, and here an observant foreman can work wonders in minimizing the cause of complaint.

The emission of smoke depends largely on the grade of coal used and is affected very much by the access of air to the fire-box, either above or below the grate. If there is too much above, then smoke may result as, similarly, it will do with too little below. A lighting-up fire built hollow will usually emit a minimum if the fire-box is kept closed, but as soon as steam shows and the blower is opened, a careful adjustment of the fire-door is recommended; a thin, hazy smoke will denote the most satisfactory combustion.

Comprehensive control of stores is very essential if the man in charge of a running-shed is to show economical working.

Finally, the running-shed foreman who attends to details of his charge efficiently himself will assuredly secure more recognition from his superior than he who is constantly worrying those in command with idle tales of tittle-tattle and complaints of those he should guide in the more acceptable routine of duty.

Automatic Train Control.

The pioneer trunk railway in this country to develop and adopt automatic train control was the Great Western Railway, and some note is desirable of the apparatus employed, seeing that 2130 miles of main

line have been fully equipped, involving some 1320 signals and 2000 locomotives.

The system gives audible signals to the engine-driver in the cab of the locomotive, corresponding to the position of the "distant" signals. When an equipped distant signal is passed at the "all right" (off) position a bell rings, and when at "caution" (on) a siren sounds, and at the same time the continuous brakes on the train are automatically applied. The application of the brakes and the sounding of the siren

continues until the engine-driver "acknowledges" the signal by lifting a small handle on the apparatus in the engine cab.

The apparatus installed on the permanent way consists of an immovable ramp between the running-lines at or near each distant signal. The ramp (Fig. 1) consists of a baulk of timber about 40 ft. long, on which an inverted tee bar is mounted, the highest

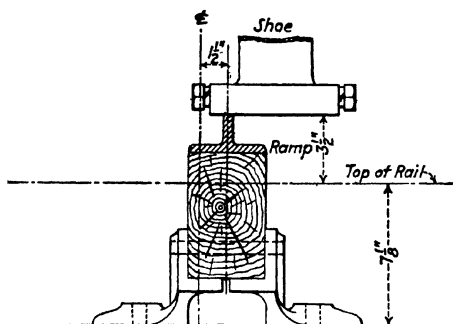


FIG. 1.—FIXED RAMP AUTOMATIC CONTROL, G.W. RAILWAY.

point being $3\frac{1}{2}$ in. above the rail level. To the ramp is connected an electric battery, the circuit from which is closed and opened by a switch coupled to the lever in the signal-box operating the signal. This switch is *closed*—thus energizing the ramp—when the signal is in the "clear" position, and is *open*—thus leaving the ramp electrically "dead"—when the signal is in the "caution" position.

The equipment on the locomotive comprises an electric battery connected to an electro-magnet, which controls a valve in the vacuum brake system. The circuit from this engine battery is closed and opened by a switch which is operated by a shoe (Fig. 2), or plunger, fixed on the centre line of the engine.

The plunger projects to within $2\frac{1}{2}$ in. of the rail level, and is consequently lifted *one inch* each time the engine passes over a ramp. When the engine is not on a ramp, the switch is closed and the electro-magnet is energized, keeping the brake valve shut. When the engine passes over a "dead" ramp—the signal being then in the "caution" position—the plunger lifts, opens the switch, and breaks the circuit. The electro-magnet is thus de-energized, and allows the brake valve to open,

admitting air to the brake-pipe through a siren, and applying the brakes.

When the engine passes over a "live" ramp—the signal being at "all right" (off)—the circuit on the engine is broken, as before, by



FIG. 2.—SHOE ON ENGINE AUTOMATIC CONTROL.

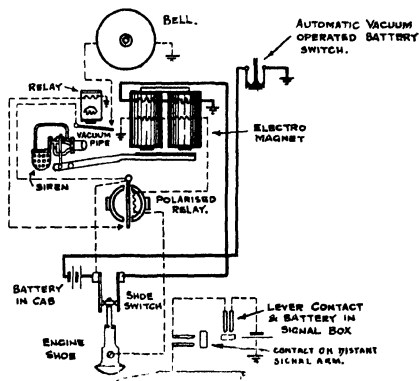


FIG. 3.—DIAGRAM OF CONNECTIONS, AUTOMATIC CONTROL.

the movement of the shoe, but the current from the ramp is picked up by the plunger, and flows through the electro-magnet, thus keeping the brake-valve shut, and also causing relays to work and to ring a bell on the engine. A diagram of connections is given in Fig. 3.

Other Systems of Train Control.

A novel form of automatic train stop has originated in Germany. Unlike other devices wherein contact is made between a "trip"

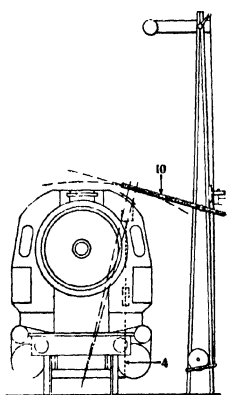


FIG. 4.

stripper, or other projection, on the locomotive or train with an inclined plane or strip on the track, in the Kofler apparatus now under notice an overhead position has been chosen for the installation of the operating gear, thus keeping it clear of all chances of being rendered inoperative by snow, ice, etc.; further, this position enables correct register or alignment between the striking elements being kept, eliminating a difficulty experienced with all mechanically-operated arrangements at track level.

Fig. 4 gives in diagram form the general arrangement of the operating details on a locomotive and signal post. Fig. 5 shows the position of the two operating "bows" held up by springs and supported in a case, which, in turn,

can be raised or lowered in the cab. The bows 2 and 3 are depressed by striking the elements 10 and 7 when passing these in the low position of "stop" or "distant signals" respectively. A novel feature of the mechanism is the means provided for carrying the case above mentioned on a cushioning spring 6 and a supporting rod 4 resting on an axle-box. The effect of depression of 2 and 3 can thus be very accurately adjusted, and is independent of any oscillation due to bearing springs, vibration, etc.

The striking arms on the signal post are so arranged that immediately on having imparted impact to a passing locomotive or car fitted they automatically move clear of the loading gauge, so that they cannot be damaged by an abnormally-loaded vehicle or other projection from a train. The striking element on the signal post resumes its position at the next movement of the signal, or it may be reset by hand.

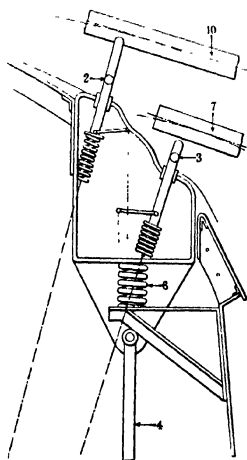


FIG. 5.

CHAPTER XVI

Special Types—High-pressure Four-cylinder Compound—Turbomotive—
Garratt Articulated—Franco Arrangement—Condensing Locomotive.

Special Types of Steam Locomotives.

CONSIDERABLE effort has been made during the last few years to improve the steam locomotive—that is to say, to secure better return from the heat developed by the fuel burned. In this country the most striking example, perhaps, is the high-pressure four-cylinder compound locomotive (No. 10,000) put into service on the London & North Eastern Railway. Here a water-tube boiler has been adopted to generate steam at a pressure of 450 lbs. per sq. in. The engine has two high-pressure cylinders, 10 in. diameter, and two low-pressure cylinders of 20 in. diameter, all having 26 in. stroke. The six-coupled driving wheels are 6 ft. 8 in. diameter, whilst the bogie wheels at each end of the engine are 3 ft. 2 in. diameter. The accompanying diagram (Fig. 1) will show the general arrangement of the engine, with the chief details, and from this the principles embodied in its construction can be easily followed.

With the decision to employ so high a working pressure as 450 lbs. per sq. in., it became necessary to choose some form of water-tube boiler, and accordingly Mr. Gresley, in conjunction with Mr. H. E. Yarrow, designed a generator of this type, which was built by Messrs. Yarrow, Ltd., of Glasgow, with particular regard to locomotive requirements. Considerable study was also devoted to the external contour of the boiler clothing in order to reduce air resistance in running by imparting a "stream line" form, and to deflect smoke and exhaust steam upwards and over the cab—a very necessary precaution in this case, as the loading-gauge limit prohibits any chimney or other protrusion above the boiler-top line. To this end Mr. Gresley and Professor Dalby carried out certain experiments at the City and Guilds Technical College by passing a current of air at 50 m.p.h. velocity through a wind tunnel in which was placed a model of the front end, while steam, etc., was simulated by puffs of powdered chalk projected through the

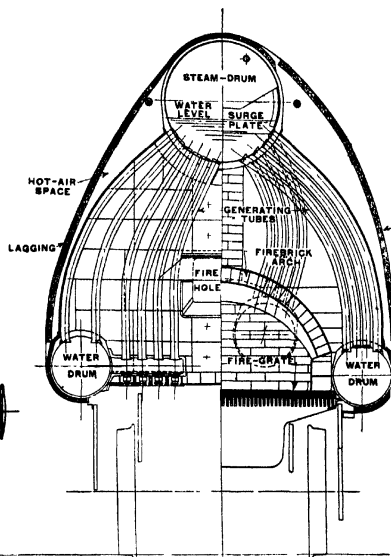
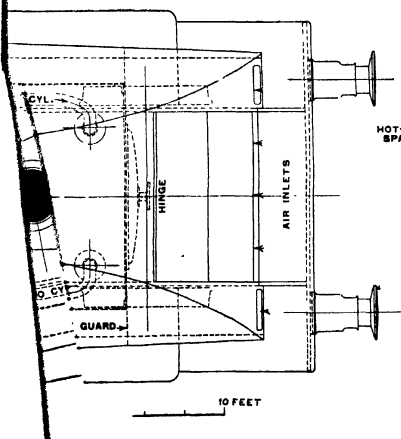
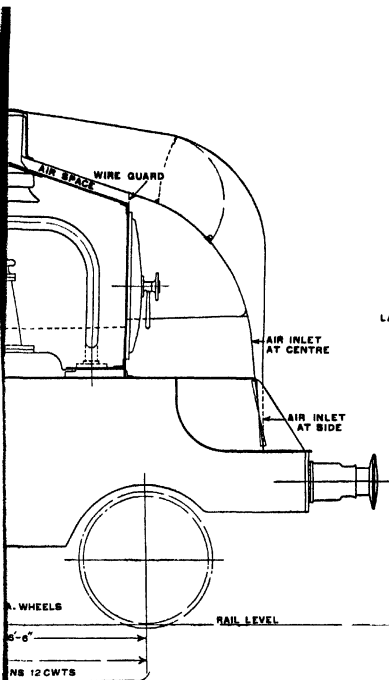
funnel. In this way a satisfactory contour for the front end was evolved, and the driver's vision protected from obstruction.

Something of the boiler structure will be gathered from the diagram. On either side of the fire-box are two water-drums, 11 ft. $\frac{5}{8}$ in. in length by 1 ft. 6 in. diameter, which are connected by 238 tubes, $2\frac{1}{2}$ in. in diameter to one upper steam-drum, 3 ft. in diameter by 27 ft. $11\frac{5}{8}$ in. long. The extended portion of this latter drum is further connected by 444 tubes of 2 in. diameter and 74 tubes of $2\frac{1}{2}$ in. diameter, with two other water-drums placed slightly higher than the first-mentioned, each having a length of 13 ft. $5\frac{3}{4}$ in. and a diameter of 1 ft. 7 in. These drums are solid forged and machined all over. In addition to the tubular ranges above mentioned, there is a back screen of twelve $2\frac{1}{2}$ in. diameter tubes.

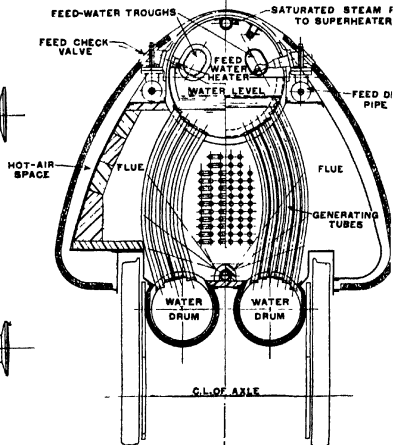
Under test at the makers' works, this boiler gave a continuous evaporation of 20,000 lbs. per hour for four hours, at full pressure of 450 lbs. per sq. in., which is, of course, more than adequate for the power output contemplated.

It may be mentioned here that the object in the design of this new and novel engine is primarily to obtain high economy rather than any considerable increase in power. Air for combustion principally enters through three rectangular orifices, one in the centre, of large size, flanked by two smaller openings, which passes between the outer casing and the flues, thus being pre-heated (an advantage making for economy) and protecting the lagging from excessive heat. The air thus supplied is controlled by means of a damper, and cold air can, if required, be admitted by another damper at the front of the ash-pan; though this further supply of air may not normally be required, this damper is required chiefly for the removal of ashes. Silting of the tubes—a contingency to be carefully combated in the case of a high-pressure tubular boiler liable to be fed with water of varying quality, has been provided against by injecting the feed-water at the forward part of the steam-drum where there are no water-tubes, and causing it to flow over a "weir" at the back of this space on its way to the evaporative surfaces. Blow-off cocks are fitted near the point of entry, and as the water is heated by the injectors to a temperature exceeding 400° F., it is hoped that most of the scale, etc., will be deposited where it can do no harm.

All ordinary boiler fittings would be quite unsuited to pressure of this order, and special forms of safety valves, regulator, water-gauges, etc., are necessitated. These have been supplied by Messrs. Cockburn & Co., of Glasgow, who specialize in the manufacture of high-pressure



HALF SECTION AT A.A. HALF SECTION AT B.B.



HALF SECTION AT E.E. HALF SECTION AT F.F.

mountings. Two injectors are fitted. One of them, made by Messrs. Gresham & Craven, operates with high-pressure steam, and the other by Messrs. Davies & Metcalfe, takes steam at lower pressure from a manifold above the fire-box door, which serves the various auxiliaries such as the sanding-gear, ejector, whistle, steam-heat, etc. This manifold furnishes steam at a pressure of 200 lbs. per sq. in., regulated by a Cockburn reducing valve. The Superheater Company supplied the special form of superheater, which is heated in the main flue on the boiler side of the regulator. The elements are connected to two forward headers immediately in front of the water-tubes and are always under full steam pressure.

Save for the addition of an extra pair of trailing wheels mounted on a Bissel truck whose centre lies under the front of the fire-box, the wheel arrangement is similar to that of the standard "Pacifics" of the L. & N.E. Railway, the spacing of the axles being the same, and also the diameter of the wheels, which is 6 ft. 8 in. for the coupled group and 3 ft. 2 in. for the leading bogie and both truck wheels. The Cortazzi axle-boxes have been retained without modification for the forward carrying axle. The addition of this extra pair of wheels constitutes a type of tender locomotive new in this country, and still extremely rare in Europe, there being possibly not more than two other examples of the "Baltic" type extant outside North America.

The two inside cylinders, which, together with the valve chambers and receiver, are formed from one steel casting, with cast-iron liners of special composition, are 10 in. in diameter by 26-in. piston stroke. They are slightly inclined and are placed well ahead to allow for connecting rods of suitable length which drive the leading coupled axle. The two high-pressure piston valves are 6 in. in diameter, have a maximum travel of $6\frac{1}{8}$ in., a steam lap of $1\frac{3}{8}$ in. and no exhaust lap, and are arranged for a maximum cut-off of 80 per cent. in full gear; the outside low-pressure cylinders are also slightly inclined in their axes. Their diameter and piston stroke is 20 in. by 26 in., the ratio of H.P. to L.P. cylinder volume being, therefore, 1.277. These cylinders are also served by piston valves, having a maximum cut-off of 75 per cent. and a maximum travel of $6\frac{1}{8}$ in. Their diameter is 8 in., and the steam lap is $1\frac{5}{8}$ in. with no exhaust lap.

The valve-gear (see p. 80) is of special interest as it allows independent adjustment of the high- and low-pressure expansions without the complication of fully duplicated mechanisms. The new arrangement removes a grave objection to practically all hitherto known systems of independent control, the theoretical advantages of which

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were seriously negated by the presence of inside eccentrics, links, etc., formidably increasing the number of moving parts. In this engine there are but two sets of Walschaerts motion which drive the outside valves in the usual way, but connection is made to the inside valve spindles by means of simple rocking shafts. The inner arm of each of these shafts is slotted, and within this slot is a movable die block to which the valve rod is attached. By moving the die block towards or away from the centre of oscillation of the rocking shaft, the travel, and consequently the cut-off of the valve, is lessened or increased. The lead is derived from the cross-head independently. Two sets of reversing gear are provided, one for shifting the radius rods in the links and one for actuating the die blocks for the high-pressure gear. For starting, high-pressure steam can be admitted to the low-pressure cylinders by a special regulator, but this is only used for a few moments, the steam-pipe, 1 in. in diameter, being purposely restricted, any excess pressure in the large cylinders is further prevented by a "pop" safety valve communicating with the L.P. steam-chests and set to blow at 200 lbs. per sq. in. Cylinders, valves and axle-boxes are all lubricated by Wakefield pumps.

Details of weight and axle loading are given on the diagram, and it is interesting to note that the weight when built only varied by 5 cwt. from that estimated by the designers. The tender accompanying this engine is of the standard corridor type, with 4 ft. 2 in. diameter wheels, and a water and fuel capacity of 5000 gallons and 5 tons respectively.

4-6-2 Turbomotive. London, Midland & Scottish Railway.

An interesting development in locomotive design has been embodied on an L.M. & S. Railway 4-6-2 "Princess Royal" class of locomotive. In place of the usual four-cylinder reciprocating type of steam engine a steam turbine has been provided with gear transmission to the coupled driving wheels. It is anticipated that this arrangement will realize a saving of 15 per cent. in coal.

It will be noted that, except for the provision of the turbines and transmission gear, the wheelbase and general appearance are very similar to the existing "Princess Royal" and "Princess Elizabeth" locomotives, built at Crewe Works in 1933.

The provision of a turbine as the prime mover was carefully investigated, and taking into account the fact that this locomotive is required to work trains of 500 tons between Euston and Glasgow, it was decided that the turbine should be 2000 h.p. non-condensing, using

steam at 250 lbs. per sq. in., with a steam temperature of approximately 750° F. The main motive-power unit comprises the multi-stage turbine, which is fitted on the left-hand side of the engine frame, and treble reduction gear of the double helical type, completely enclosed in a fabricated gear-case which is suspended from three supports on the engine frame and is restrained from moving sideways relative to the turbine.

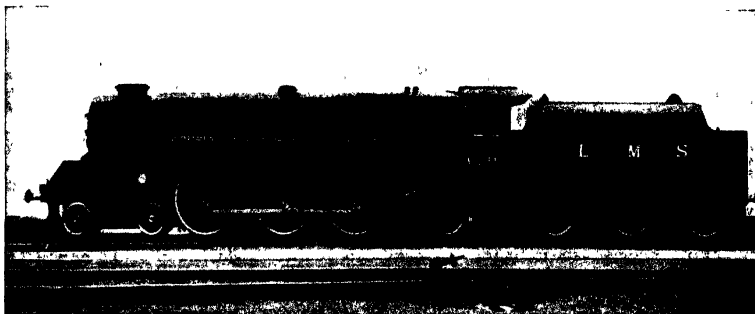


FIG. 2—4-6-2 TURBOMOTIVE, No 6202, LONDON, MIDLAND & SCOTTISH RAILWAY.

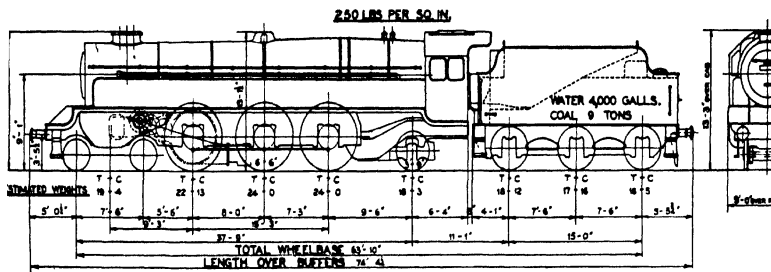


FIG. 3.—DIAGRAM OF TURBOMOTIVE

For reverse running a separate turbine is provided on the right-hand side of the engine frame. There is an additional single reduction gear, making in all, for reversing, a quadruple reduction gear between the turbine spindle and the driving axle.

The method of operation of the locomotive differs somewhat from the orthodox type, since provision has to be made for reversing by means of a dog clutch situated between the reverse turbine and the final drive.

The forward turbine is permanently connected through to the

transmission gear and, therefore, when the reverse turbine is in operation the steam supply to the forward turbine is cut off and the drive from the reverse turbine is engaged by means of a steam-operated arrangement. This can only be achieved when the engine is stationary, a safety device being incorporated in the transmission, to prevent the change

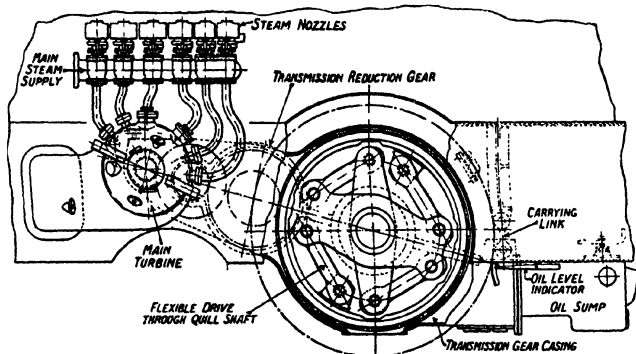


FIG. 4.—DIAGRAM OF TURBINE AND FLEXIBLE DRIVE.

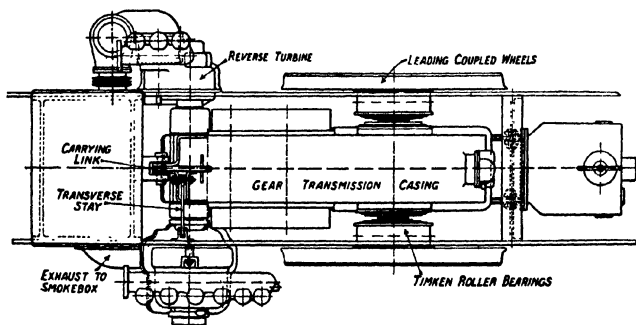


FIG. 5.—PLAN OF TRANSMISSION—TURBOMOTIVE.

being made whilst the engine is in motion. When the drive from the reverse turbine has been engaged, the steam supply to this unit can then be opened. From the foregoing it will be appreciated that when the engine is running tender first, the forward turbine blades move in the reverse direction.

The steam supply to the two turbines is taken first through the main regulator on the boiler (which is kept fully open while the engine

is in motion), and then to the regulators on the nozzles of the two turbines, there being six in the case of the forward turbine, and three in the case of the reverse. These are operated from the control-box in the cab, and by means of suitable interlocking devices between the reversing clutch mechanism and the turbine regulators, it is impossible to admit steam to the forward turbine when the reverse turbine is in gear, or vice versa.

All the bearings for the turbines and transmission gears, etc., are lubricated mechanically from an oil well at the rear end of the gear casing in which is submerged a gear pump.

The boiler has been designed to supply superheated steam at 250 lbs. per sq. in. pressure. The barrel plates and fire-box wrapper plates are made of 2 per cent. nickel steel to keep down the weight, and the barrel is tapered. The fire-box is extended into the boiler barrel to form a chamber for the more complete combustion of the gases.

A steam manifold is provided in the cab, and carries valves for the following fittings: Injectors, ejector, steam brake for engine and tender, carriage warming, pressure gauge, gear case oil circulating pump, single-feed lubricator to regulator and whistle; a single valve controls the supply.

An exhaust steam injector, with 12 mm. cones, is fitted on the right-hand side, and on the left, or driver's side, a live steam one with 13 mm. cones. The exhaust steam injector feeds through a feed-water heater supplied by steam from the forward turbine. Both injectors deliver to the boiler through top-feed clack valves. Sliding trays are fitted underneath the water delivery nozzles inside the boiler to permit periodic cleaning.

There are four "pop" safety valves 2½ in. diameter, whilst other boiler mountings, such as water-gauge frame and protectors, etc., are standard.

The superheater elements are of the bifurcated type from single downcomers which carry spherical ball joints to the superheater header.

The main regulator is incorporated with the superheater-header casting inside the smoke-box. The control for the regulator is of the usual type, but to ensure easy manipulation the handle is balanced, and a small sight-feed lubricator in the cab, under the control of the driver, supplies lubricant to the regulator valve.

The provision of a turbine in place of the reciprocating power unit has necessitated a considerable modification to the smoke-box arrangement. In view of the low pressure exhaust of the turbine, it has been necessary to provide a double exhaust type of blast-pipe which, in turn, requires a double-bore chimney. The orifice of the blast-pipe is varied

automatically by means of a central cone dart which is raised or lowered as the number of steam nozzles for the turbine is increased or decreased. Another unusual feature is the provision of a radiator at the front for oil cooling.

Special joints at the smoke-box side between the steam pipes and turbine steam chest ensure flexibility for expansion, etc.

The main frames of high tensile steel are $1\frac{1}{4}$ in. thick.

At each side of the rear two separate frame plates are spliced to the main frames, and carried through to the buffer beam. The outer frames are splayed outwards, and the inner main frames inwards, to take the centre casting for the trailing truck.

All the laminated bearing springs for the engine and tender are made of silico-manganese steel, the plates being of a ribbed section with cotter type of fixing in the buckle. The springs have screw adjustment. Rubber damper springs are provided between the spring link heads and the frame brackets.

Steam brake gear is provided, the brake-blocks being arranged at the front of each of the coupled wheels. The driver's brake valve controls simultaneously the application of the steam brake on the engine and the vacuum brake on the train.

All the journals of the coupled driving wheels are provided with roller bearings lubricated from wells arranged in the underkeeps.

The intermediate drawgear between engine and tender is controlled by a laminated spring housed in the tender drag-box. The main drawbar is directly connected to the spring buckle.

Side bolsters transmit the load from the main frames to the leading bogie which has bearing springs of the inverted laminated type, with screw adjustment. Roller bearings are fitted to the bogie journals.

The trailing two-wheeled truck is of the Bissel type, and the bogie frame is anchored to the cross stretcher casting immediately in front of the fire-box throat plate. As in the case of the leading bogie, the weight from the main frames is taken through side bolsters. Roller bearings are fitted to the journals.

The wheel centres are steel castings, with rims of triangular section; the tyres are secured by "Gibson" retaining rings.

As there are no reciprocating parts there is consequently no hammer blow. Balance weights are provided in the coupled wheels for the revolving weights of the coupling rods only, these being the only unbalanced moving parts of the motion. The balance weights are of steel plates provided on both sides of the spokes and riveted, weight being secured by filling in between the plates with lead.

The coupling rods of rectangular section are of high tensile manganese molybdenum steel.

Double sliding windows are fitted on both sides of the cab, and on both outsides on the outside of the cab and between the sliding windows a small glass screen can be turned into position so that when the engine-men are looking outside the cab it acts as a draught preventer. A hinged window giving ample area for lookout is fitted on each side in the front cab plate. Tip-up seats are fixed on both sides of the cabs, and gangway doors are fitted between the engine cab and tender-plate.

The sanding gear is of the trickle type, the sand being delivered in front of the leading and in front and behind the intermediate coupled wheels. In addition, a water de-sanding apparatus is provided similar to that on many new engines of the L.M. & S. Railway.

The main particulars are:

Boiler Barrel.—19 ft. $5\frac{3}{8}$ in. long; 5 ft. $8\frac{5}{8}$ in. outside diameter, increasing to 6 ft. 3 in.

Fire-box.—32 superheater elements, $1\frac{1}{4}$ in. diameter outside by 13 S.W.G.; 32 large flues, $5\frac{1}{2}$ in. diameter outside by 7 S.W.G.; 112 small tubes $2\frac{1}{4}$ in. diameter outside by 11 S.W.G. Distance between tube plates, 19 ft. 3 in.

Heating Surface.—Tubes, 2097 sq. ft.; fire-box, 217 sq. ft.; total, 2314 sq. ft. Superheater, 653 sq. ft. Grate area, 45 sq. ft.

Weights in Working Order.—Engine, 109 tons; tender, 54 tons 13 cwts.; total, 163 tons 13 cwts.

The steam supply for carriage warming is taken from the turbine exhaust, the working pressure being set at 50 lbs. per sq. in. In the event of the turbine not being in operation, an auxiliary supply of steam is available direct from the boiler.

Grease-gun lubrication is utilized wherever possible, as for instance, on brake gear and intermediate buffing gear.

The tender is carried on six wheels, with a wheelbase of 15 ft., and has a capacity for 4000 gallons of water and 9 tons of coal. The bunker has been designed so that the coal will be self-trimming, as far as possible.

Roller bearings are provided for all the tender axles.

Beyer-Garratt articulated Locomotives.

To secure machines of sufficient power on tracks of limited strength and with loading-gauges of limited dimensions, resort has had to be made to articulation—that is to say, the engine is arranged on a flexible wheel-base. One of the designs which has received much favour is known as the Beyer-Garratt system, and a good example of this is one

for the 3 ft. 6 in. gauge in New Zealand (Fig. 6). This particularly illustrates the many claims put forward for the Beyer-Garratt system, and the following descriptive note will be interesting.

The particular engines illustrated for the New Zealand Government Railways have been designed to abolish double heading and banking in working heavy mail trains over gradients of 1 in 40 and through curves of 3-chains radius. The scheduled speeds call for a velocity of 50 m.p.h. on a level in places, so it is apparent that these locomotives are required to combine a capacity for high speed with a very great tractive effort. This latter feature they certainly possess, for reckoned on the conservative basis of only 75 per cent. boiler pressure, T equals 51,580 lbs., which gives an adhesion factor of 3.8 when the engine is



FIG. 6.—4-6-2+2-6-4 SIX-CYLINDER BEYER-GARRATT LOCOMOTIVE, NEW ZEALAND GOVERNMENT RAILWAYS.

fully laden. So great a tractive force as 343.9 lbs. per 1 lb. m.e.p. necessitates driving wheels of modest diameter, and consequently fairly high piston velocities, but these are compensated by the lightness of the moving parts and the employment of three cylinders upon each motor unit. The large total cylinder volume thus given has been advantageously exploited by making use of the principle of "limited cut-off," which by restricting the maximum admission to 50 per cent. ensures an economical steam consumption at all times and helps to prevent such wheel slip as might arise from unskilful handling of the regulator.

Each group of three cylinders is set in line above the four-wheeled bogies, and is inclined at a moderate angle. It may well be imagined that the inclusion of three cylinders on a 3 ft. 6 in. gauge engine, particularly in conjunction with inside frames, was a matter calling for great ingenuity and forethought, but by arranging passages integrally

in the casting in a really remarkable fashion, all difficulties have been successfully surmounted and full freedom assured for the flow of steam to and from the three cylinders of the group. All the cylinders have a diameter of $16\frac{1}{2}$ in. and a piston stroke of 24 in., with steam distribution by inside-admission piston valves actuated by external Walschaert gear for the outside pairs and the system of conjugating levers to the middle cylinders.

The coupled wheels are 4 ft. 9 in. in diameter and have a wheel-base of 10 ft. 9 in., this being the only rigid portion out of a total wheel-base of 25 ft. 5 in. for each unit. The four-wheeled bogies have wheels 2 ft. $6\frac{1}{2}$ in. in diameter, while those of the two-wheeled trucks have a diameter of 2 ft. 9 in.; the axle-boxes of these latter, it may be mentioned, are provided with radial arms and controlled side play. Each group of coupled wheels have air-sanding apparatus at front and rear, and brake-blocks, actuated by hand or air, apply to all of them. Grease lubrication serves the coupled axles, which have bearings of special bronze, as have also the connecting and coupling rods. The pivots between the boiler frame and the power units are lubricated by mechanical pumps, and incorporate an important improvement by means of which end-play due to wear can be readily adjusted in the running-shed, without dismounting the unit.

Relatively enormous proportions characterize the boiler, which has a working pressure of 200 lbs. per sq. in., a total evaporative surface of 2274 sq. ft., and a grate area of 58.3 sq. ft., a figure exceptional even for British standard-gauge locomotives. The tubes and flues have a length between plates of 12 ft., and respectively number 224 and 43, the diameters being $1\frac{3}{4}$ in. and $5\frac{1}{4}$ in. external. The latter enclose the elements of the superheater, 43 in number, which have an outside diameter of $1\frac{3}{8}$ in. and afford a superheating surface of 520 sq. ft. The diameter of the boiler barrel, which is cylindrical in form, is 6 ft. 6 in. outside, with axis pitched 7 ft. 7 in. above the rail. The mountings comprise a steam dome, three "pop" safety valves, and a double-clack top-feed valve to which water is delivered by one live steam injector and one exhaust steam injector.

The round-top fire-box has an external length of 10 ft. 6 in. and the following inside dimensions: from grate to centre line, front, 5 ft. 6 in.; rear, 4 ft. 3 in.; from centre line to crown, front, 1 ft. 3 in.; rear, 1 ft. 1 in. The heating surface, including that contributed by the thermic syphons, is 266 sq. ft., and the staying is effected by flexible stays. The grate, which is of the mechanically operated type, measures 9 ft. $8\frac{1}{16}$ in. by 6 ft. internally, and has a large hopper ash-pan fitted

with sliding doors at side and bottom. Coal fuel is fed by a mechanical stoker, the arrangement of which is simplified by carrying the coal-bunker upon an extension of the main frame, without, however, involving any violation of the "Garratt" principle or interfering with the correct location of the articulating pivot. The photographs of the footplate and above the bunker clearly show how ingeniously the multiplex organs have been installed within a space necessarily restricted, and are yet accessible and convenient for operation.

Fittings not hitherto mentioned include two air-compressors (the air-cylinders of which are finned); hydrostatic lubricators for the cylinders, air-pumps and stoker; train heating apparatus; and electric head and cab lights.

Six tons of fuel are carried in the bunker and the water capacity of the tanks is in all 4000 gallons, of which 2450 gallons are contained in the front tank and the remainder at the rear. Both tanks are well elevated to ensure full accessibility to the inside details, and the weights are disposed so that the diminution of fuel and water does not greatly affect an equitable axle loading. This is commendably uniform, ranging, when full, between 14 tons 13 cwt. and 14 tons 7 cwt. on the coupled axles; 18 tons 12 cwt. and 19 tons on the leading and hind four-wheel bogies; and 9 tons 14 cwt. and 10 tons 19 cwt. respectively, borne by the two-wheel trucks of the leading and trailing units. The total adhesion weight is thus 87 tons 18 cwt. out of a total weight of 146 tons, of which 73 tons are taken by each motor unit. The total wheel-base is 76 ft. 7½ in.; the height from rail to chimney-top is 11 ft. 6 in., and the greatest breadth 8 ft. 6 in.

Large Beyer-Garratt Locomotive for Russia.

The illustrations (Figs. 7 and 8) hardly give an adequate impression of the size of this engine, for the harmony of the design, together with the great height of the chimney permitted by the generous Russian loading-gauge, tend to obscure its immense proportions, which may, however, be gathered from the following particulars: rail gauge, 5 ft.; total wheel-base, 98 ft. 8 in.; length over buffers, 109 ft.; width across platforms, 10 ft. 6 in.; height from rail to chimney-top, 17 ft. 1.9 in. The tractive effort is 3076 kg. per kg./cm.² m.e.p. in the cylinders (477 lbs./1 lb./sq. in.), or on Messrs. Beyer, Peacock's moderate figure of 75 per cent. boiler pressure, 35,680 kg. (78,700 lbs.); the corresponding factor of adhesion with the engine in full working order is 4.26, since the adhesion weight is 152 tons out of a total weight of 259 tons.

This great tractive effort has not been obtained through a restriction

of wheel diameter, and the size of the coupled wheels, together with the inherent stability of the Beyer-Garratt system, easily allows a speed of 45 m.p.h., which considered as a quality for clearing congested lines, is of almost equal importance as its capability of dealing with exceptionally heavy loads.

In conformity with the Beyer-Garratt principle, each motor unit is identical in formation and spacing of the wheels, and the frames of these units are formed of steel bars 5 in. thick, machined all over, braced by cast-steel cross members. The heaviest of these is constituted by the cylinders, which are of steel in two pieces for each pair of cylinders. Behind the cylinders is a massive box frame stay which houses the



FIG. 7.—4-8-2+2-8-4 BEYER-GARRATT LOCOMOTIVE, RUSSIAN SOVIET RAILWAYS.

“ Miner ” friction-draught gear used in conjunction with the Willison “ transition ” couplers. Side buffers are also fitted.

The coupled wheels are 4 ft. 11 in. in diameter, and are spaced 5 ft. 5 in. apart, but of the coupled base of 16 ft. 3 in. only 10 ft. 10 in. is rigid, as the outermost coupled wheels are flangeless. The outer bogies, with wheels 3 ft. 1 in. diameter, are allowed a total side play of 7½ in. and the inner two-wheel radial bogies a side play of 3 in. These latter have wheels 3 ft. 5 in. diameter, fitted with Bottomley boxes and rocking brasses. Thanks to these arrangements, the engine can traverse curves of 10-chains radius, notwithstanding the long wheel-base of each unit.

Overhung laminated springs sustain the coupled and inner bogie wheels with beam compensation between the outer and intermediate coupled axles, and the driving, inner coupled and truck axles respectively, the connecting links having knife-edge seatings. The coupled axle

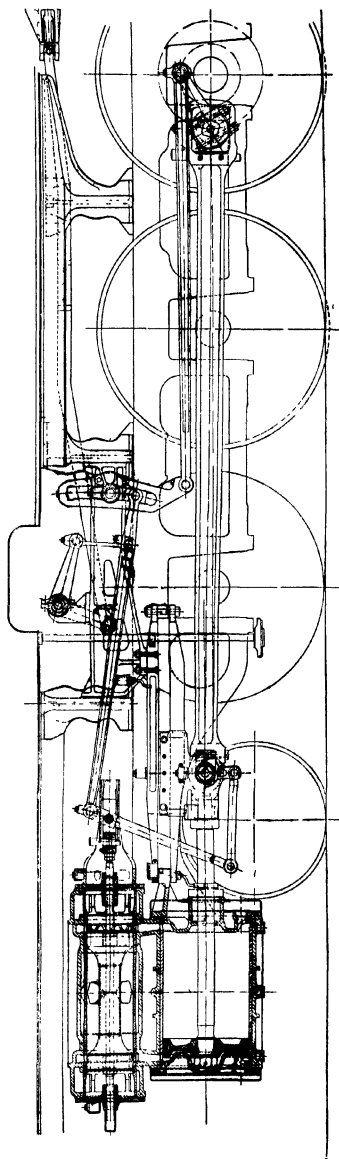
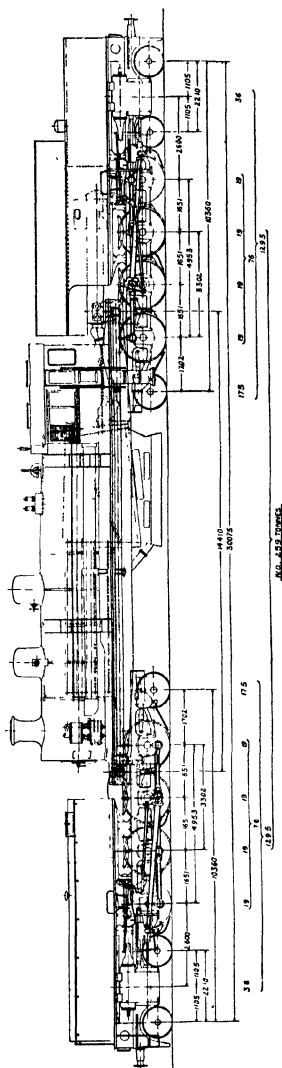
journals are $9\frac{1}{4}$ in. diameter, and run in cast-steel axle-boxes with oil-wells in the crowns and siphon lubrication, besides bottom lubrication pads.

All four cylinders are 570 mm. (22.44 in.) diameter by 710 mm. (27.95 in.) piston stroke. They are horizontal, but with axes about 2 in. above the centre line through the wheels. The front cylinder covers, in conformity with modern Russian practice, are formed in two pieces, of which one is a disc ground on its periphery to bed with the cylinder face, and the other is an outer ring held by studs to retain it in position. The attachments to the cylinders include "Okadee" automatic cocks operated by air, Hendrie by-pass valves, United Kingdom packing for the piston-rods, liners of special grade cast-iron, and the valves and cylinders are lubricated by two six-feed Wakefield pumps, each supplying one feed to the barrel and two feeds to the steam-chest.

Steam is distributed by piston valves of the hollow type, 12 in. in diameter by $3\frac{1}{2}$ in. across the heads, which give inside admission through ports of large area. The maximum valve travel is 6 in., at which they cut off at 65 per cent., but are provided with small auxiliary ports to facilitate starting. The spindles work in guides made integrally with the chamber end-covers, and the links of the Walschaert gear (Fig. 9) are of the open pattern supported by trunnions attached to a bridge casting, which also carries the outer ends of the slide-bars and reversing shaft bearings.

The piston-rods are $4\frac{1}{2}$ in. diameter and are guided by crossheads of the "Laird" type. The drive is to the third pair of wheels through connecting rods fitted with solid rectangular big-ends and bearings adjustable by split bushes and cotttered wedges. The distance between the centres of these rods is 13 ft. 7 in., so that the ratio of crank-throw radius to length is about 1:11.64; and to ensure lightness, they are deeply fluted, as also are the coupling, radius, and eccentric rods. Control of the valve-gear is effected by an air-operated "Alco" servomotor with hand-screw gear as an auxiliary.

All coupled wheels are braked by the Westinghouse automatic and straight-air systems, supplemented by hand-screw gear in the case of the hind unit. The compressor is of the compound two-stage type, and is driven by superheated steam. Sand is distributed by Leach compressed-air apparatus to the front of the outer coupled and driving wheels and also to the rear of the inner coupled wheels of each group. The sand for the latter is contained in boxes seen near to the inner truck wheels, but for the other points large-capacity boxes are fitted



at the forward end of the recess provided in the front tank for withdrawal of the boiler tubes; and on the rear unit the caps of the sand fillers project from the sides of the bunker, the receptacles being neatly concealed under the sloping walls of the coal-hopper.

The central member is built of deep plates with intermediate cross-stays and cast-steel box stretchers at either end which incorporate the pivot centres; these being of the Beyer-Peacock patent adjustable type lubricated by grease and oil delivered from nipples accessibly placed for the grease-gun. Expansion brackets and separate smoke-box saddle castings support the boiler, which is of a type commonly employed by the builders but remarkable for its vast size, the weight of the boiler alone being about 40 tons. The 600 cubic ft. of fire-box volume furnishes all necessary space for free combustion without the need for an extended chamber, and as the Garratt system allows a grate practically unrestricted in breadth, this type of engine gives a freedom and simplicity of boiler design hardly possible with other forms of articulated locomotive.

The total evaporative surface is 331.1 m.^2 (3564 sq. ft.), of which the tubes and flues contribute 299.7 m.^2 (3226 sq. ft.), and the fire-box (including five arch tubes) 31.4 m.^2 (338 sq. ft.). There are sixty flues 136.5 mm. (5.25 in.) diameter and 246 tubes of 50.8 mm. (2 in.) diameter, the length between tube-plates being $15 \text{ ft. } 3\frac{1}{8} \text{ in.}$ All are composed of steel. The barrel is pitched 3.000 m. ($9 \text{ ft. } 10.1 \text{ in.}$) from rail to centre line, and is formed in two rings, of which the major external diameter is 2.310 m. ($7 \text{ ft. } 6.9 \text{ in.}$) and the length 4.500 m. ($14 \text{ ft. } 9.16 \text{ in.}$), the plate thickness being $\frac{3}{8} \text{ in.}$ For the outside fire-box, which is of the round-top form, the wrapper plate has a thickness of $\frac{1}{8} \text{ in.}$, the back sheet $\frac{5}{8} \text{ in.}$, and the throat sheet $\frac{3}{4} \text{ in.}$ The inner fire-box is of steel, and is welded throughout, with water-spaces 4 in. in width at the foundation ring increasing to 6 in. at the top, the wall stays being of "Longstrand" steel. The roof is shaped as a flattened ellipse, radially stayed, and both sides and roof are $\frac{1}{8} \text{ in.}$ with a tube-plate of $\frac{5}{8} \text{ in.}$ thickness. The crown slopes gently to the rear, being 480 mm. (18.9 in.) and 403 mm. (15.86 in.) at the front and back from centre line to roof. The corresponding measurements to the foundation ring bottom are 2.080 m. and 1.676 m. ($6 \text{ ft. } 9.9 \text{ in.}$ and $5 \text{ ft. } 5.9 \text{ in.}$). The outside length and breadth is $12 \text{ ft. } 9 \text{ in.}$ by $8 \text{ ft. } 0\frac{3}{4} \text{ in.}$ The grate has an area of 8 m.^2 (86.11 sq. ft.), the length being 3.630 m. ($11 \text{ ft. } 10.9 \text{ in.}$) by 2.200 m. ($7 \text{ ft. } 2.6 \text{ in.}$) wide inside. It is divided into four rocking sections, each pair being operated by steam or by hand at will. The drop-grate is in two portions and is situated in the centre, operation being by hand-levers on the sides of the ash-pan, which is provided

with air-doors on the ends and on the upper sides near the foundation ring, the air entering through the latter being deflected downwards by inclined plates inside.

The centre of the ash-pan is divided longitudinally by a tunnel, through which passes the exhaust pipe from the rear unit, and the sides of this tunnel which slope outwards to meet the inside sloping floors from the sides, are provided with sliding doors worked by steam to give a free discharge of the ashes, cleaning being assisted when required through the doors on the exterior of the ash-pan.

With a grate and fire-box of such capacity as that of this engine, hand-firing for anything more than a brief period would hardly be practicable, and a mechanical stoker of the standard B.K. type has therefore been installed. It is arranged very accessibly (the cylinders of the driving motor are seen in the photograph between the cab and the bunker), and is driven by superheated steam. For its lubrication, a British Detroit hydrostatic sight-feed apparatus is provided, which also furnishes oil to the Westinghouse air-pump, while the gearing of the coal conveyer is lubricated by a grease-gun through various nipples. The Franklin fire-door, of the "butterfly" pattern, is air-operated through a treadle lever, and cleanly tubes are assured by Dudgeon and Havart soot-blowers fitted on the fire-box side and worked from the cab. There are also blow-off cocks, similarly actuated, on the sides of the boiler.

The smoke-box has an outside diameter of 7 ft. 11½ in. and a length from front to tube-plate of 6 ft. 11⅞ in. This latter plate is of the drumhead form and is made of steel $\frac{7}{8}$ in. thick, the segment above the tube range being stayed by rods extending diagonally from the roof of the barrel. A spark arrester and hot-water ash ejector are provided, and the blower takes superheated steam.

The boiler mountings comprise an encased steam turret, whence steam is taken to various fittings and auxiliaries; a turbo-generator; four 3-in. Ross patent "pop" safety valves set to blow at a working pressure of 15 atm. (220 lbs. per sq. in.); a steam dome, and another similar dome (that nearest the chimney) which houses a water purifier of the cascade type with sludge-cocks worked from the cab.

From the steam dome steam passes through a shut-off valve in the main pipe to a Superheater Company's superheater of sixty elements with tubes 35 mm. (1.38 in.) external diameter, giving a surface of 112 m.² (1205.6 sq. ft.) outside, and thence through a multiple valve regulator in the header to the cylinders, the steam-pipe to the hind unit being housed in a lagged casing along the right-hand side of the boiler. The ball-joint connections to the mobile units are lubricated by a two-

feed Wakefield pump. The throttle is actuated by an external rod connected to a vertical suspended quadrant lever in the cab, which is pushed forward to open. Ready access to the domes and turret is afforded by ladders on the boiler side, and all hand-rails, pillars, and clothing belts are made of stainless steel.

When full, the tanks have a total capacity of 37 m.³, of which 24.25 m.³ (856 cu. ft.) is contained in the front tank and 12.75 m.³ (450 cu. ft.) in the rear. These tanks are throughout of welded construction, and are replenished through two holes at the rear of the front tank, the hind tanks filling through the equilibrium pipe and therefore requiring no filling vents, though a man-hole is provided. The bunker has a coal capacity of 16 tons.

Water is fed by a No. 14 Davies & Metcalfe combination live-steam injector and by a No. 13 exhaust-steam injector supplied with steam from the main exhaust pipe of the rear engine. This latter injector is fitted immediately in front of the fire-box, and is enclosed by a casing as a protection from the intense cold sometimes experienced (as low as -40° C.) against which, indeed, many precautions have been taken throughout. For example, a small steam-pipe leads to the feed-well on the equilibrium pipe, and to the branches of this pipe, located at the ends of the boiler cradle, steam is taken from the turret to heat the water supply from the tanks. The pipe from the exhaust injector to the purifier clack-box runs under the boiler clothing, and the live-steam injector feed-pipe is housed within the boiler, uniting with the exhaust-injector feed inside the dome. The mechanical lubricators are warmed by steam coils placed beneath them, and all steam, water, and oil-pipes are protected by casings and mattresses or by asbestos cord wrappings.

The engine crew are most comfortably housed in a roomy cab having a floor space of about 100 sq. ft., the length being 10 ft. 1 in. by 10 ft. wide and the height 7 ft. 6 in. It is completely lined with wood, and has sliding-glass side windows and louvre side shutters. Fresh air is furnished by two large rectangular ventilators in the roof. The back of the cab is fully enclosed when the mechanical stoker is in action, but there are doors which may be opened to give access to the bunker and for hand-firing, should this be required. The controls, gauges, Teloc tachygraph, etc., have been arranged with great attention to convenience of position, and the more important of these can be reached from the upholstered seats provided for the men. The cab is electrically lighted on Stone's system, which also supplies current for the head, side, and tail lights.

A novel and somewhat remarkable design of articulated steam

locomotive has been tried recently on the Continent, for which a high thermal efficiency is claimed, and at the same time "effects considerable economy in fuel consumption and in the cost of maintenance."

"Franco" articulated Locomotive.

The design illustrated (Fig. 10) consists of three sections, A, B, and C, each having its own set of cylinders and coupled wheels. In all there are eight cylinders, ten pairs of coupled wheels, and five pairs of carrying-wheels. The middle unit B carries the boiler, and this is connected by ducts to two outer sections A and C, which carry tubular feed-water heaters and economizers, with smoke-boxes and chimneys.

The double boiler has a central fire-box, divided into two separate combustion chambers by a diagonal cross-partition. The fire-box is

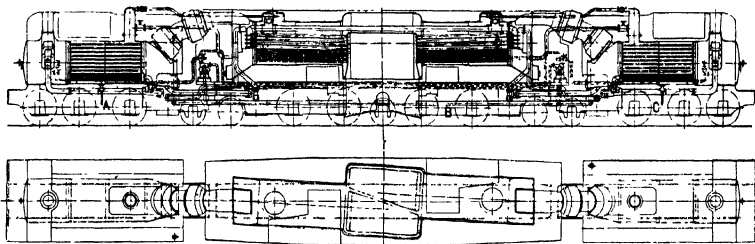


FIG. 10.—THREE-UNIT "FRANCO" LOCOMOTIVE BUILT BY THE ATÉLIERS MÉTALLURGIQUE AT TUBIZE. 6-2+2-4-2-4-2+2-6 TYPE.

extended laterally beyond the width of the tube-plates, so that a fire-hole can be provided on opposite sides of the boiler. Firing can be carried on simultaneously from each side by firemen stoking longitudinally as in an ordinary locomotive, but in opposite directions; two firemen are therefore necessary. It is claimed that this arrangement of boiler gives an increase in direct heating surface, better circulation, separate draught through the respective fire-tube systems, reduction in the dimensions of the fire-brick arches, and the possibility of cleaning one grate without interfering with the working of the other.

The main centre unit B has two sets of four-coupled wheels, each driven by pairs of outside cylinders arranged at the outward ends of the frames. These outer ends are supported by pairs of carrying-wheels with another pair at the centre—three pairs in all.

The outer sections A and C of the locomotive also act as driving units, as they are each mounted on six-coupled driving wheels with outside cylinders at the inner ends of the frames. The extra weight

of the cylinders is supported by a further pair of carrying-wheels. Each of these outer unit frames carry a tubular feed-water heater, with a smoke-box containing a blast-pipe, and of course provided with a chimney.

Exhaust steam from the four cylinders of the main boiler unit B passes through the lower tubes of the feed heaters, which are therefore steam-tubes, raising the temperature of the surrounding water to about 100° C., and contributes effectively to the feed heat.

The waste fire-box gases from the main boiler pass through the upper tubes of the heaters, and are therefore smoke-tubes which serve to raise the temperature of the water to that corresponding with the working pressure of the boiler, this being possible as both heaters and boiler are connected by piping and consequently are working at the same pressure. Feed-water is pumped into the heaters from tanks carried on the two outer units.

It should be pointed out that the water-level of the main boiler is higher than the top of the heaters, so that the latter are always full of water, even on the steepest gradients, and the boiler is ensured of its feed-supply equal in quantity to that pumped into the heaters from the tanks.

Draught is obtained in the usual way by the cylinder exhaust drawing the waste gases into the smoke-boxes.

A portion of the exhaust steam from the cylinders of the main boiler unit is led to the ash-pan, where it mixes with and warms the air for combustion drawn into the ash-pan.

In consequence of the inclination of these steam-pipes downwards, the condensed water is allowed to damp the ashes in the ash-pan, and keeps it wet in proportion to the power being developed by the boiler.

The designers argue that, with this boiler, the whole of the heating surface is used for converting water into steam, no additional heat being required to raise the temperature of the feed-water to boiling-point. As the feed-water is always at a high temperature, all scale is precipitated in the heaters, and not in the boiler, thus reducing the maintenance cost.

It is claimed, when using coal of 7500 calories value, evaporation is obtained with an average coal economy of about 20 per cent., as compared with that secured in the ordinary type of boiler.

Mention should be made of the method adopted for articulation by means of pins and links. The arrangement gives great facility of movement and allows the locomotive to work smoothly at high speed, as each unit is independent and bears its own weight. Double-acting check-springs dampen all hunting oscillations of the separate frames.

Referring to the accompanying drawings shown by Fig. 11, Nos. 1 and 2 indicate by elevation and plan the three frames A, B, and C.

Small coupling rods of identical shape 6 are linked to the beam castings 3 and 4 of frame No. 1, the left-hand rods being connected to the front portions, the right-hand rods to the rear ends, or vice versa, while the left and right vertical link-pins are symmetrically located in relation to the centre line of the frame.

The other ends of the rods 6 are linked to ears 12 of the link pivoted on 14. Pivot 14 can turn in the cylindrical cavity of ball 16, contained in the socket of a rigid structure projecting from frame 2. Double-acting check-springs 10 serve the purpose of dampening the hunting oscillation of frames A, B, and C.

It is evident the left-hand rods 6 and the right-hand rods 6 also are

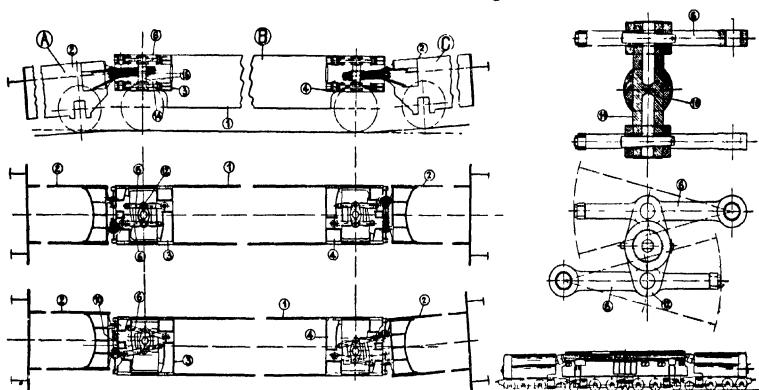


FIG. 11.—ARTICULATED COUPLINGS OF THE THREE "FRANCO" UNITS, AND SMALL EXTERNAL VIEW OF GENERAL ARRANGEMENT.

continuously subject to both tensile and compression strains, irrespective of the direction of motion of the locomotive.

Further, each of the units A, B, and C moves freely and independently when turning or hunting, and assumes any required position in regard to the longitudinal axis.

The dimensions of the first three-unit "Franco" locomotive for freight traffic illustrated, and which has been tried on the Schaarbeck-Luxembourg line, are as follows:

Cylinders (8)	17 $\frac{1}{8}$ in. diameter by 25 $\frac{5}{8}$ in. stroke.
Coupled wheels	4 ft. 6 in. diameter.
Total heating surface of main boiler	2,700 sq. ft.
Superheater surface	834 "
Total heating surface of feed-water heaters	2,900 "
Grate area	70 "

Working pressure of main boiler and feed-water heaters	200 lbs. per sq. in.
Capacity of water tanks	7,930 gallons.
Capacity of coal-bunkers	9 tons.
Total weight in working order	243 "
Weight of central unit in working order	108 "
Adhesive weight	167 "
Weight in working order of outer units	135 "
Tractive effort at 75 per cent. of working pressure	83,128 lbs.
Coal consumption per hour	5,800 "

On a test run made on the Schaerbeck-Libramont section, 94 miles, on 12th December 1932, with a train of 1200 tons, the water evaporated was 176,500 lbs., and the coal burned, 17,730 lbs.

"Franco" Locomotive for Russian Railways.

The capabilities of the "Franco" locomotive are well illustrated by the design (Fig. 12) for a three-unit compound locomotive for freight traffic for the 5-ft. gauge Russian railways. This is of the 2-4-4-2 + 2-8-8-2 + 2-4-4-2 type, with four high-pressure cylinders $25\frac{1}{2}$ in. diameter and eight low-pressure cylinders of the same diameter; the stroke of each is also $25\frac{1}{2}$ in.

The diameter of the driving wheels throughout is 4 ft. $5\frac{1}{8}$ in.

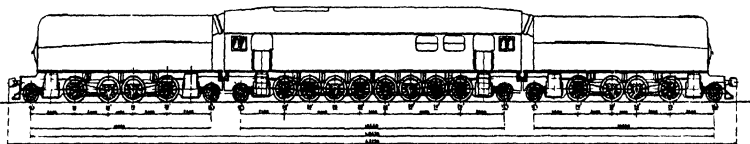


FIG. 12.—THREE-UNIT COMPOUND FREIGHT LOCOMOTIVE, 2-4-4-2+2-8-8-2+2-4-4-2 TYPE.
DESIGNED FOR THE RUSSIAN RAILWAYS.

The working pressure of the main boiler is 227.5 lbs. per sq. in., and the heating surface 5200 sq. ft. Heating surface of the fire-box gases pre-heaters, 5200 sq. ft.; heating surface of the exhaust pre-heaters, 860 sq. ft.; superheating surface, 1980 sq. ft.; grate area, 142 sq. ft. Capacity of water tanks, 13,000 gallons; capacity of coal bunkers, 11 tons. Tractive effort, 148,000 lbs. Maximum speed, 31 miles per hour.

Condensing Locomotive.

Another interesting development includes the application of a condenser to locomotives, which is of course to economize in the use of water—a very important consideration in countries where a supply of good water is difficult to obtain. An illustration (Fig. 13) is

appended, showing a 2-8-2 locomotive recently built for a South American railway. It has the following leading dimensions:

Cylinders, 18 in. diameter by 22 in. stroke.
Coupled wheels, diameter 3 ft. 6 in.
Carrying-wheels, diameter 2 ft. 6.7 in.
Rigid wheel-base, 11 ft. 9 in.
Total wheel-base, 26 ft. 2 in.
Total heating surface, 1400 sq. ft.
Superheater surface, 404.7 sq. ft.
Weight of engine, in running order, 61 tons.
Weight of tender, empty, 34 tons.
Weight of tender, in running order, 48 tons.
Water capacity, 1568 imperial gallons.

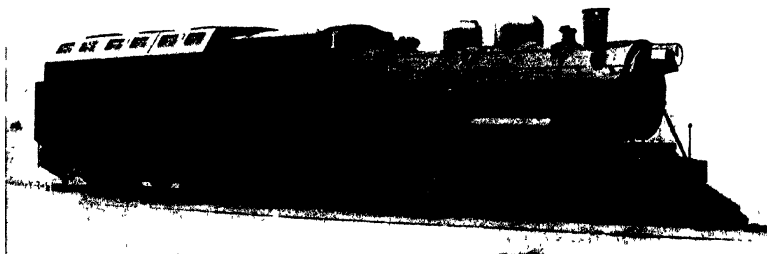


FIG. 13.—2-8-2 CONDENSING LOCOMOTIVE, ARGENTINE STATE RAILWAYS.

The chief feature is the arrangement for the exhaust steam which, instead of passing up the chimney to the atmosphere, is led to an exhaust turbine on the tender (Fig. 14). Fans, driven by the exhaust steam turbine, draw an air stream through the radiator elements, which condense the steam under atmospheric pressure. The condensate is fed back into the boiler by means of pumps, the water thus being in continuous circulation. The slight losses due to leakage during the circuit are made good from the supply of water carried in the tender-tank. This water, however, is not led into the boiler direct, but is first passed through a small evaporator, the steam from which is likewise condensed in the condenser. The water is thus kept perfectly pure during its entire circuit. De-aeration of the condensed water is provided for, in order to preserve the boiler from corrosion. The exhaust steam is cleaned by passing through an oil separator. Experience has shown that the separation of oil from the exhaust steam is complete and, consequently, that the heating surface of the boiler remains clean. As no exhaust steam is

available for creating the necessary draught, an induced-draught blower, consisting of a turbine and blower-wheel, is arranged in the smoke-box just below the chimney.

Although the special feature of the design was the saving in water consumption, and its consequent saving in cost of boiler maintenance, its arrangement was kept as simple and reliable as possible, with the object of securing a favourable temperature drop between the steam to be condensed, and the outside air acting as the cooling agent. No attempt has been made to obtain the benefit of a vacuum for extra propulsive effect in connection with the condensation process, and this enables a comparatively small condenser to be sufficient. Further,

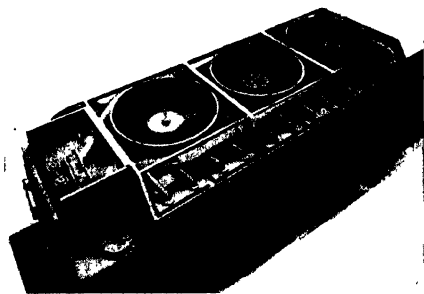


FIG. 14.—EXHAUST STEAM TURBINE CONDENSING TENDER.

fuel economy was not aimed at; nevertheless, in spite of the fact that the locomotive is equipped with certain additional auxiliaries, consuming live steam, in actual service it has often proved more economical in fuel consumption than locomotives of ordinary type. The condenser, fans, and turbines have been so arranged that it is unnecessary for the steam pressure, on entering the turbine, to be higher than is customary in the blast-pipe of an ordinary locomotive; consequently the cylinder performance is practically unaffected. It should be mentioned that oil fuel is used.

The locomotive covered 19,000 miles, hauling trains of an average weight of 945 tons, with a water consumption figure which represented an economy of 95·4 per cent., as compared with locomotives of the same type without condensing apparatus; the average consumption of water was 2·9 gallons per mile.

CHAPTER XVII

Internal Combustion Oil Engines—Diesel, Diesel-electric, and Electric Locomotives of various types—
Pneumatic Tyres for Railcars, etc.

FOLLOWING the exceptional examples of steam locomotives described in the last chapter, it will be well to record the great progress made in the introduction of the internal combustion oil engine for locomotive purposes. These can be divided into three classes: First, those in which the oil engine relies upon mechanical details for transmission of power to the driving wheels; secondly, those having some hydraulic or pneumatic system of transmission; and thirdly, perhaps the most popular, electrical transmission. The locomotives relying on mechanical transmission are confined to those of small power, or intended to work as independent units—as, for instance, railcars, of which a striking example (**Diesel-engined Railcar**) is given in Fig. 1, illustrating a high-speed railcar built for one of the British railways. It is of unique design in contour and shape, the outcome of exhaustive tunnel tests to reduce wind resistance, which at speed requires more power to overcome than is required to drive a car along the rails. In appearance it resembles a huge seaplane “float” with flush-fitting observation windows running along the top part, and merging at each end into sloping control cabins.

The car is 62 ft. long and 11 ft. 4 in. high. It weighs 20 tons, and has been designed for a maximum speed of 60 m.p.h. Seating capacity is for 69 passengers. The car is driven by an A.E.C. 130-H.P. Diesel engine using non-inflammable fuel. It has six cylinders, 115 mm. bore by 142 mm. stroke, giving a swept volume of 8.85 litres, and weighs, complete with fly-wheel, electrical equipment, oil-filter and all accessories, only 1477 lbs. In mechanical design the unit is similar to a modern petrol engine. The maximum governed speed is 2400 r.p.m. Light weight and high speed have therefore received special attention in the design.

The sides of the car extend to within a foot of the track, so that practically the whole of the vehicle, including wheels, is enclosed in a stream-lined case. Everything possible has been enclosed, even to the head and tail lamps, controlled from the driver's seat, which are fitted flush with the case. The effect of this stream-lining has been to reduce wind resistance to one-fifth of that encountered by a similar square-

ended car. The engine, radiator and driving parts are situated under the floor on one side of the car near the middle doorways, and all can be easily inspected or repaired by merely removing an inspection cover.

Transmission of power from engine to wheels; drive to wheels; brakes and controls, which are duplicated, so that the car may be driven from either end, are identical with those used on modern cars and buses.

Entrance to the car is in the middle, through double doors, which open into a vestibule 5 ft. wide. Two large compartments lead off from this, each with a centre gateway. On each side are seats ranged



FIG. 1.—STREAM-LINED DIESEL-ENGINED RAILCAR, GREAT WESTERN RAILWAY.

back to back, upholstered in pleated brown leather and fitted with cellular rubber cushions to give the maximum amount of comfort. Racks for light articles run along the side of the car.

Fig. 2 shows a small locomotive arranged with a lorry body. The engine is of 74 H.P., and the vehicle intended for a 3 ft. 6 in. gauge.

Pneumatic-tyred Railcars.

A more ambitious development is the **Micheline Motor Railcar**, Fig. 3, which shows a pneumatic-tyred light railcar, intended for high speed. It is of interest to note that this car, which is 45 ft. 6 in. long over all, seats 36 passengers and has also a compartment for 10 cwt. of luggage. It is geared to give a maximum speed of 63 m.p.h., fully laden, and will maintain a cruising speed of 56 m.p.h. The engine, of 180 H.P. at 3000 r.p.m., with a reverse gear of four speeds in either direction, is fixed to the body chassis; the fuel consumption averaging 6·3 m.p.g. The power bogie has three axles, two of which are coupled by chains and radius rods. Suspension is by semi-elliptic springs

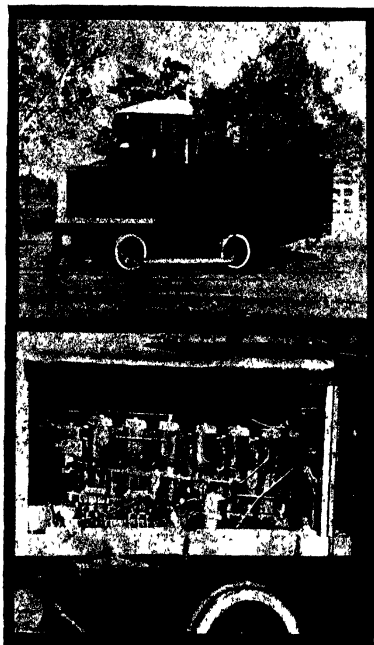


FIG. 2.—DIESEL LOCOMOTIVE WITH LORRY BODY AND 74 H.P. GARDNER OIL ENGINE, CLOGHER VALLEY RAILWAY.

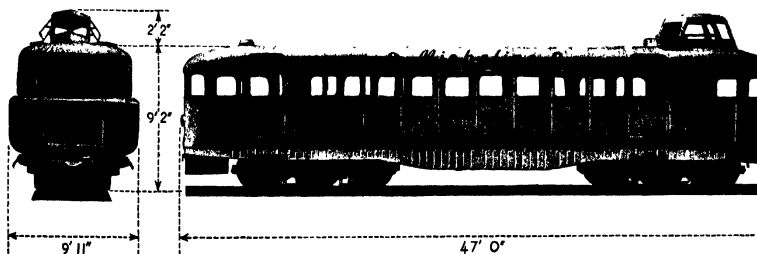


FIG. 3.—MICHELINE PNEUMATIC-TYRED RAILCAR FOR HIGH SPEEDS.

outside the wheels, and rubber blocks, and gives stability at all speeds. The pressed-steel disc wheels with steel guiding flanges, silenced by a rubber insert, have special Michelin pneumatic tyres, 34 in. diameter on tread, and inflated to a pressure of 95 lbs. per sq. in. A puncture alarm warns the driver of the deflation of any tyre.

With pneumatic tyres it has hitherto been impossible to obtain the benefits of track circuits; this difficulty has now been effectually overcome by providing eight slipper blocks which complete the circuits.

There are two independent hydraulic braking systems, one acting



FIG. 4.—ARMSTRONG-WHITWORTH OIL-ELECTRIC LOCOMOTIVE DURING TRIALS ON THE LONDON & NORTH EASTERN RAILWAY AT BLAYDON.

on the front bogie and the other on the rear bogie. The normal braking will stop the car from 50 m.p.h. in 220 yards, but an emergency application on a dry rail will bring it to rest in 130 yards, and on a wet rail in 160 yards.

The passenger compartment has large safety-glass windows, and efficient ventilation is provided by blowers with air-ducts at the front and suction fans at the rear. Hot-air heating is from the engine radiator. When the vehicle is standing ventilation is assured by two ventilators.

The steel chassis is of light steel construction, welded throughout, and weighs only 16 cwt. The total weight of the vehicle in running order is 7.1 tons and, fully laden, 10.3 tons.

Oil-electric Locomotive.

The oil-electric locomotive shown in Figs. 4 and 4A represents a further stage in the progress of oil-electric traction on British railways. Although not the most powerful yet built, it is intended for use, when

required, with one or more similar units (a feature not incorporated in the larger individual engines so far constructed), and therefore is a step towards the utilization of greater powers.

It is not only in regard to the flexibility afforded by the "unit" type of locomotive (one, two or more units being coupled together and driven by one crew), but by its versatility that the present locomotive is unique. Electric transmission permits full utilization of the power of the oil engine from six to sixty miles per hour, and therefore the locomotive is equally suitable for goods trains scheduled at 20 m.p.h.



FIG. 4A.—ARMSTRONG-WHITWORTH OIL-ELECTRIC LOCOMOTIVE ON GOODS TRAIN AT BLAYDON.

average speed, as well as for fast passenger trains running at a maximum of 70 m.p.h.

The chief particulars of the locomotive are—

- B.H.P. of main and auxiliary engines, 880 B.H.P.
- Weight in working order, 72 tons.
- Maximum axle-load, 17 tons.
- Tractive effort, 28,500 lbs.
- Loading-gauge, a composite British loading-gauge.
- Length over buffer-beams, 36 ft. 6 in.
- Fuel capacity $\left\{ \begin{array}{l} 900 \text{ miles passenger working.} \\ 1500 \text{ miles goods working.} \end{array} \right.$

The main dimensions may be seen from the accompanying drawing, Fig. 5.

A 2-6-2 type of locomotive, guided by single-axle pony-trucks, was preferred to the bogie type on account of the high speeds specified, whereas the bogie type, when two units are permanently articulated together, is capable of speeds of over 80 m.p.h.; the short distances

between bogie centres precludes this arrangement being adopted in the case of units to be used singly. Moreover, the 2-6-2 type will run equally well in either direction, arrangements having been made to avoid complete symmetry by using different designs of pony-truck and truck springs at the two locomotive ends, as will be seen from the drawing. Compensation is carried out between one pony and its neighbouring driving axle, and between the other pony and the remaining two axles. The driving wheels are 4 ft. diameter, and the truck wheels, 3 ft.; 12 in. by 5½ in. Isothermos axle-boxes are employed. Braking is by the vacuum apparatus, with couplings for connection to passenger stock, and is effected by a rotary exhaustor acting through 24-in. Westinghouse cylinders. Compressed-air sanding is fitted.

The structure is built up on the 1-in. plate frames, with cross stretchers at suitable intervals, and capable of supporting the engine generator set upon what is virtually a three-point support. The housing is formed of steel sections and sheets in which welding has been to a great extent employed; no extreme measures have been necessary in keeping the weight down to the adhesion necessary. A section of the roof is removable for the purpose of lifting out the main engine set during locomotive overhauls, and the auxiliary engine is accommodated under a bonnet at one end of the vehicle; the bonnet, though of robust construction, is hinged and easily lifted in the same manner as the bonnet of a lorry engine. Fig. 6 shows the engine generator being lowered into its place.

Ventilation of the interior is ensured by partitioning off the engine from the generator and allowing the generator to draw in cool air through louvres and then to discharge it into the engine-room proper, from which it escapes through the roof ventilators.

The engine is a British-built 8-cylinder Armstrong-Sulzer heavy oil engine, of the same size as that used on the Paris Ceinture Railway. Two cast-iron cylinder blocks are built up on a welded steel crank chamber, which forms, with the circular extension of the generator, what is virtually a single tubular unit comprising engine and generator, which can be lifted out of the locomotive, and which, when resting on an elastic seating, provides the three-point support previously mentioned. Full power is developed at 700 r.p.m., and two reduced speeds are provided for medium power and for idling, though with the arrangements made for continuous easy starting of the main engine, the latter speed is only to a limited extent when in regular service.

The cylinder liners are of special cast-iron, the pistons of forged aluminium alloy, and the connecting rods are chrome nickel steel forgings. Cooling is effected by a direct driven pump circulating the

water through Serck radiator elements, elements also being provided for lubricating oil cooling. As in all Armstrong-Whitworth locomotives of large power, these elements are arranged on each side of the locomotive with ducts leading up to a single fan placed in the roof; in this case a Davidson Aerto fan motor driven and thermostatically controlled. Fuel tanks are arranged on each side of the engine-room, and of sufficient capacity for British requirements; larger tanks can be incorporated for overseas needs where runs of 1000 miles have to be negotiated between re-fuelling depots.

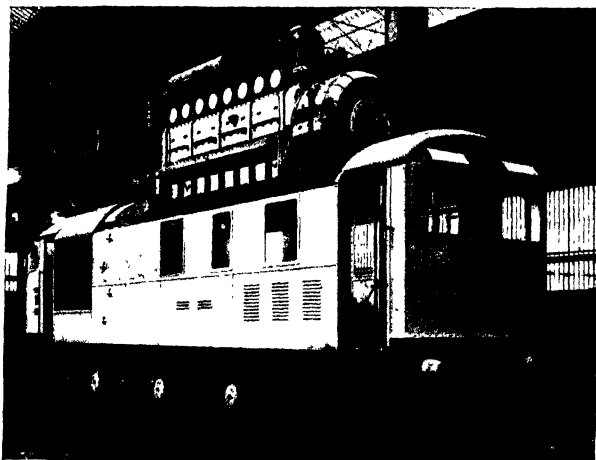


FIG. 6.—THE ENGINE GENERATOR BEING LOWERED INTO THE 880 H.P. STANDARD GAUGE OIL-ELECTRIC LOCOMOTIVE AT THE SCOTSWOOD WORKS

An interesting feature is the fitting of a stream-line lubricating oil renovator, which obviates the necessity of drawing off oil, cleansing it in suitable renovators in the running-sheds and returning it to the locomotive. This filter being in constant use allows of only occasional make-up oil having to be added, amounting on the average to 1 per cent. of the lubricating oil used by the engine.

Oil-electric Locomotives.

As an example in the development of oil engines with electric transmission, Fig. 7 shows an oil-electric train-set recently put into service on the San Paulo Railway, Brazil.

Owing to the exigencies of the service, involving as it does the traversing of the incline of 1 in 12½ to an altitude of 2600 ft., by means of the famous ropeway, from practically sea-level about seven miles from Santos to the level of the table-land of the State of San Paulo, it is necessary that the train-set shall conform to the very particular requirements. Not only does it have to work at different altitudes at very short intervals, but owing to the length of passing-loops on the Sierra inclines, the over-all length has to be restricted.

The train is of three-coach formation, with the power unit articulated to the first coach. The second and third coaches also are articulated, whilst the connection between the first and second coaches is by simple



FIG 7.—OIL-ELECTRIC TRAIN, SAN PAULO RAILWAY, BRAZIL

draw-gear. The train has been designed for a maximum speed of 65 m.p.h., the drive being by means of four motors, two being mounted on the bogie under the power unit and two on the rearmost bogie, thus spreading the tractive force over the whole length of the train.

Current is supplied by the main engine-generator set, the engine being a 6-cylinder Armstrong-Sulzer airless injection, completely enclosed, traction type, running at 750 r.p.m., with automatic forced-feed lubrication to all parts, and with the safety devices in the oil and water circuits which shut down the engine in case of failure of supply of either the oil or water. There is also a special engine-control device fitted, whereby at a moment's notice the output of the engine may be varied so as to adjust it to suit working at sea-level or on the Sierra at 2600 ft. altitude.

The starting of the engine is electric. An auxiliary engine-generator set which runs during the operating time of the train takes all auxiliary loads, thus obviating the use of heavy batteries.

Cooling of the water and oil for the main engine is by means of a panel type cooler and electric fan placed to one side of the power unit. Immediately above the auxiliary engine is placed the cooling-water tank, and alongside this in the roof of the power unit is the fuel-service tank. The main fuel tank is placed at the side of the power unit.

A rotary exhaustor, driven by an electric motor, for the vacuum brake is placed towards the rear of the power unit.

The main engine is mounted on two longitudinal " I " beam members with channel cross-stiffeners.

The power unit bogie is arranged with plate sides and Isothermos axle-boxes, while springing is by means of laminated springs. Special attention has been paid to the necessity for light weight, and consequently all the sections have been adopted with a view to securing rigidity with a minimum of weight.

Braking is by means of standard clasp-brakes on both sides of all four wheels. The axle suspended motors are suspended on shock-absorbing buffers at the nose.

The articulated bogies are of special light weight construction, and the load from the articulating joint is transferred to the bogie frame through double helical springs by means of the bolster; springing to the axle-boxes is of orthodox form with leaf-springs. The bogies under the coaches are also very light and the wheels are braked on both sides.

The main framing of the coaches consists of braced longitudinal girders of all-welded construction. The cross-members supporting the coachwork are of light channel section and are bolted to the main longitudinals. The coach bodies are of very light all-metal construction mounted on the under-frames and not built integral with them.

The body framing consists of pressed-steel pillars of " U " section. The flanges are riveted to the waist rails and cant-rails, the flanges being cut away between inside waist and cant-rails to allow of the windows and louvres being easily removed.

All the compartment windows are of the full-drop type and are fitted with an inner louvre. Both windows in the driver's compartment are of safety glass, and an electric windscreen wiper is fitted to the fixed window in front of the driver. The interior panelling is of plywood covered with leather to the waist-line in the first-class compartments and teak finish above, whilst the second-class compartments are painted cream and brown.

The total seating capacity is for 100 first class and 68 second class, the seats in both classes being of the reversible type. The first-class seats are covered with rattan and fitted with head-rests; the second class are of polished ash slats.

In addition to the three lavatories, a buffet has been arranged, fitted with racks and cupboards and with a small ice-chest complete with ice-store.

A driving compartment is arranged at each end of the train so as to permit of a shuttle service being run and obviating the turning of the train, or terminal movements of any description.

Control of the train is entirely automatic and is of the Armstrong patented system of voltage control, whereby the full horse-power output of the engine is economically utilized throughout the whole speed range of the train.

The complete train weighs 92.6 tons in running order, and 103.6 tons loaded with passengers and luggage.

Danish Oil-electric Locomotives.

Following the successful operation of oil-electric locomotives, the Danish State Railways have recently conducted a series of trials with a Diesel motor of the Burmeister and Wain single-acting enclosed, forced lubricated, 6-cylinder locomotive type, using airless injection and developing normally 450 B.H.P. at about 550 r.p.m. It was built to the standard 4 ft. 8½ in. gauge. The main generator on the continuous current system, at a voltage up to 650 volts, is directly coupled to the Diesel engine, no elastic coupling or flywheel being fitted, as the motor is specially designed to withstand the elastic deformation of the locomotive, and is perfectly balanced.

The exciter dynamo and dynamo for charging the batteries are coupled together and driven off an extension of the main generator shaft by a belt.

Starting of the Diesel motor is effected by using the generator as a motor and drawing current from the storage battery, which consists of 33 cells with a capacity of 500 ampere hours on the 5-hour rate of discharge.

The locomotive is carried on two bogies, one of four wheels and the other on six wheels. The body, which is of wood construction, is divided into five compartments, comprising in the middle the engine compartment, a boiler-room and a luggage compartment, and at each end of the car is a driving compartment with a door and gangway giving access to an adjoining car (Figs. 8 and 9).

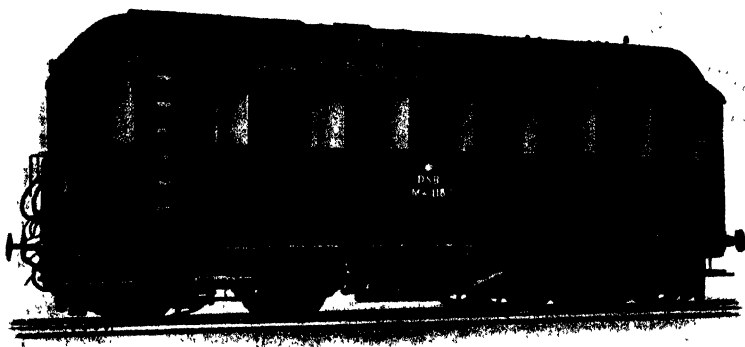


FIG. 8.—BURMEISTER & WAIN DIESEL-ELECTRIC LOCOMOTIVE FOR THE DANISH STATE RAILWAYS.

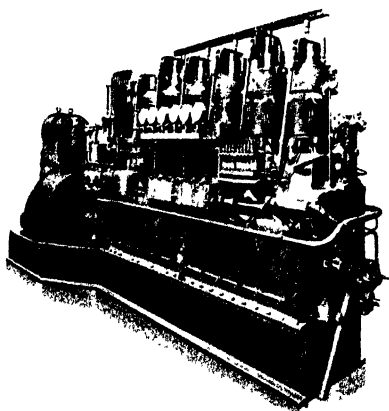


FIG. 9.—DIESEL ENGINE INSTALLATION FOR BURMEISTER & WAIN LOCOMOTIVE

The principal dimensions are as follows:

Total length over buffers, about 40 ft. 11 in.
 Length of body, 35 ft. 9 in.
 Maximum width, 9 ft. 6 in.
 Height from rail, 14 ft. 1½ in.
 Height from rail to buffers, 3 ft. 4½ in.
 Diameter of driving wheels, 3 ft. 6½ in.
 Diameter of carrying-wheels, 3 ft. 2 in.

For cooling the circulating water and lubricating oil a radiator and two ventilating fans are arranged above the luggage compartment, the capacity being sufficient for service in all seasons of the year.

The two driving motors are of the enclosed tramway type, and each drives one axle of each bogie. Both air- and vacuum-brakes are fitted to the locomotive.

During the trials a maximum speed of 60 m.p.h. was attained when hauling a train of 220 tons total weight, excluding passengers and luggage.

Oil-electric Locomotive.

The accompanying photograph (Fig. 10) shows a 600-B.H.P. oil-electric locomotive of the AIA-AIA type, which was put into service on the Paris, Lyons and Mediterranean Railway in recent times. Prior to delivery, the main contractors, Brown, Boveri & Co., carried out comprehensive trials with trains of various formations on the Hauenstein line in Switzerland.

Originally intended for heavy shunting work only, it was decided at the commencement of construction to employ the locomotive on branch line work also, and the wheel arrangement was therefore modified from the B₀-B₀ type to the AIA-AIA lay-out, thus reducing the maximum axle load from 18·5 metric tons to 16 metric tons. The under-frame is made up of steel plates with reinforcing angles in place of the more usual rolled sections. The principal dimensions are as follows: adhesion weight, 63 tons; total working order weight, 83·75 tons; driving wheels, 3 ft. 9 in. diameter; bogie wheel-base, 8 ft. 2 in.; total wheel-base, 28 ft. 6 in.; over-all length, 42 ft. 4 in.; maximum speed, 35 m.p.h.; maximum tractive effort (maintained up to 2·5 m.p.h.), 41,000 lbs. The locomotive is able to start a trailing-load of 700 tons on a 1 in 70 grade, the hourly rating of the electrical equipment corresponding to a speed of 3·75 m.p.h. with this combination of load and grade.

The prime mover is a 6-cylinder M.A.N. oil engine developing 600 B.H.P. at 690 r.p.m., and weighing 5·75 tons. The fuel tanks

have a capacity of 330 gallons, which is sufficient to last for twenty-two hours' work, the P.L.M. Company having stipulated that the locomotive must be capable of putting in that amount of service every day. The



FIG 10.—OIL-ELECTRIC LOCOMOTIVE, PARIS, LYONS AND MEDITERRANEAN RAILWAY.

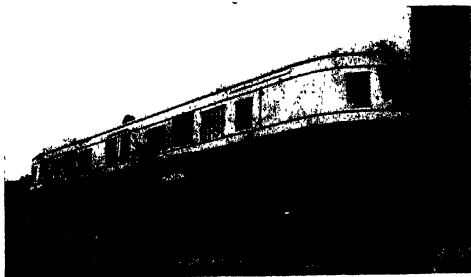


FIG 11 —ARMSTRONG DIESEL-ELECTRIC RAILBUS.

engine is direct-coupled to a D.C. generator, which also performs the functions of a starting-motor, the current for this purpose being supplied by a cadmium-nickel battery. Attached to the main generator is an overhung exciter, which, in addition to providing the current for varying the main generator voltage, also supplies the engine-cooling fan and the

compressor motor for the standard P.L.M. Westinghouse-Henry brake, which applies blocks on all the driving wheels.

Diesel Railbus.

This Diesel "railbus," as the new vehicle has been called, can claim to be the lightest "60-seater," self-propelled coach for railway service made in Great Britain, weighing as it does $17\frac{1}{2}$ tons in working order and seating either 57 or 71 passengers, according to whether or not a luggage compartment is required (Fig. 11).

The Armstrong-Saurer standard 95-H.P. commercial road vehicle oil engine is employed, and the A.B.E. (patented) electrical transmission is used. It eliminates the usual starting-motor, and charging and lighting generator supplied with any form of mechanically driven vehicle.

It is claimed the simple electrical transmission system has a life twice that of any mechanical gear, and its maintenance costs are considerably less.

Bogies of orthodox but light construction are employed, and care has been taken in the design of the vehicle to avoid loss of reliability and safety.

The general particulars are as follows:

Length over body	52 ft. 6 in.
Maximum width	8 " 11 $\frac{1}{2}$ "
Height above rail level	11 " 11 $\frac{1}{4}$ "
Bogie wheel-base	7 " 0 "
Distance between bogie centres	30 " 0 "
Diameter of wheels	2 " 9 "
Total weight in working order, with 95-B.H.P. engine .	17 tons 13 $\frac{1}{2}$ cwt.
Maximum axle-load with car loaded	5 $\frac{1}{2}$ "
Total weight in working order if fitted with 140-B.H.P. engine	18 " 17 "
Maximum axle-load with larger engine and car loaded .	6 "

An interesting feature of the design is, perhaps, the effective streamlining of the coach ends and sides, which are proportioned to reduce air resistance to the minimum, compatible with making the full use of the coach length and width. A deep skirting surrounds the railbus to diminish eddies under the frame, without in any way diminishing access during inspection and maintenance, while for overhaul purposes it may easily be removed in sections.

The tare weight per passenger seat of 0.31 (57 passengers), or 0.25 (71 passengers), is largely effected by the disposition of the engine in the centre of the railbus between the under-frame members and below

the floor; normal maintenance work and inspection may be carried out from above by lifting the trap-doors in the vestibule, while the deep under-frame, with sheet-metal housing completely enclosing the engine, protects the latter from dust, and has ample inspection covers.

The body provides an example of light road-vehicle construction adapted to the more rigorous requirements of railway service: this is permissible by using two deep-pressed steel under-frame members, centrally placed, instead of the usual channel sole-bar construction. The roof, of silver spruce board, is supported on ash hoopsticks strengthened with mild steel carlines; the front and rear portions are of 20-gauge silver finish steel, hand-beaten to shape, the whole roof being covered with waterproof canvas coated with white lead.

The exterior is panelled in 18-gauge aluminium, except the ends, which are of hand-beaten steel. The ceiling is of Salamander panelling, the interior panelling of birch ply, both ceiling and roof being finished in scratch-proof Rexine with mahogany mouldings. The parcel-racks, also covered in Rexine, are built in and form spacious accommodation for hand-luggage. All fittings, where not of chromium-plated metal are Doverite covered. Half-drop windows, in light metal frames, are fitted in the passenger compartment, with fixed safety-glass driving-windows and drop-windows in guard's compartment and drivers' cabs. Seating is of the Park Royal "tub" type, two- and three-seat pattern, upholstered in moquette over Latex rubber cushions; the framing of the seats is of plywood flitched with steel, and is claimed to be lighter and more durable than that of any metal construction. The floor is of $\frac{3}{4}$ -in. grooved pine-boards covered, in passenger and driving compartments, with a layer of Insulwood and then with $\frac{3}{8}$ -in. cork carpet. The guard's and luggage compartments are complete with the usual railway's requirements; drop-seats of an ingenious pattern are fitted in the two drivers' cabs.

Coach heating is by means of a small radiator through which passes some of the engine cooling water; a belt-driven fan directs the warm air upwards through a duct to two smaller ones running the full length of the passenger compartment, at the skirting-board, and fitted with a sliding louvre between each pair of seats. Passengers may, therefore, adjust to their liking the flow of warm air issuing from the louvre at their feet. A cock in the water-piping system enables the water to be cut off from the radiator in warm weather, and the fan then provides a supply of fresh air to be blown into the car.

The power unit comprises the standard Armstrong-Saurer commercial vehicle heavy oil engine, with the A.B.E. patented transmission.

The use of this simple electric transmission may appear strange on a light railbus of this description, and it may be asked why the standard Armstrong-Saurer road vehicle gear-box could not have been employed. The selection of the A.B.E. transmission is a proof of the claim that the advantages of a completely flexible and constant horse-power electric drive can be obtained without sacrifice of lightness, and without increasing the initial cost of the vehicle beyond a price comparable with that of shorter-lived and (from the point of view of the engine) more exacting mechanically driven rail vehicles. The feature of constant horse-power amply compensates for the rather higher efficiency of the gear-box which, however, can only make the best use of the engine at its two or three fixed working speeds.

The 95-B.H.P. and the 140-B.H.P. Armstrong-Saurer Diesel engines are both of the 6-cylinder type, running at maximum speeds of 2000 and 1500 r.p.m. respectively. The cylinders are fitted with dry liners, and the built-up crankshaft runs in roller bearings. Three-point support of the power unit in rubber "silent-bloc" bushes is used, but in addition a carefully designed laminated spring suspension prevents any trace of vibration from being transmitted to the chassis. The usual electric starting-motor and lighting dynamo are both replaced by the A.B.E. generator, bolted on to the crank-case in place of the usual gear-box, while the final drive is by a traction motor rigidly mounted in the under-frame, cardan shaft and Craven-Guest worm-drive. The A.B.E. patented transmission is manufactured to the design of Armstrong-Whitworth by Laurence Scott & Electromotors Ltd., of Norwich. Engine cooling is effected by two radiators, one at each end of the car, mounted opposite an opening in the stream-lined skirting.

An interesting departure from the conventional controller of electric transmission is provided in the control fitted to this railbus, this being, from the driver's standpoint, nearer to the steam locomotive pattern. Three levers, working in a slotted cover, operate the throttle, the forward and reverse drum, or the engine stop and start switch, the necessary apparatus being, for simplicity and economy, incorporated in one set (instead of the usual two sets), situated near the engine and controlled by compensated heavy-duty steel-wire rope running on pulleys. A lightly operated dead-man's button fitted to the end of the throttle handle allows perfect safety with one-man operation, without causing any fatigue or inconvenience when driving.

A departure has been made from the usual railway type of braking, while still adhering to a pattern with which the modern railway workshop is familiar. Ferodo-lined expanding shoes work in brake-drums

mounted on the inside of the running wheels: the four brakes of each bogie being actuated by a small compressed-air cylinder, linked with the hand-brake rigging of the near driver's cab. Rise and fall of the axle in the horn-guides is permitted by allowing the expanding brakes to ride on lubricated bushes on the axle. A small standard motor-driven Westinghouse air compressor keeps the reservoir automatically filled to the correct pressure. The dead-man's button on the throttle lever, when released inadvertently, applies the brake in addition to cutting off power; an emergency brake-valve is situated in the vestibule.

The under-frame is composed of two pressed-steel flanged plates, fish-bellied to allow of the elimination of all unnecessary weight. Pressed-steel stretchers are provided at intervals between the two longitudinals, and the utmost use has been made of these for the supporting of the engine-generator set and traction motor, etc. Bumpers are fitted at the ends of the under-frame, and a link is carried in the tool-box to enable the railbus, in emergency only, to be coupled to standard draw-gear.

The swing-bolster bogies are of an unusually light but rigid design, rendered possible by welding. Flanged plates are combined with pressed channel sections to form bogie frames of box-girder form, and transoms are of flanged-plate construction. The laminated axle-box springs are carried upon hangers fitted with "silent bloc" rubber bushes. Spiral bolster springs are employed, and hemispherical side bearings support the vehicle under-frame through rubber pads, the centre guiding pivot carrying no weight.

Wheels are of 2 ft. 9 in. diameter, and built up on Lang wooden centres, the tyres being, of course, bonded to the axle to allow the operation of track circuits.

Axle-boxes of the Isothermos type are fitted.

High-speed Pneumatic-tyred Railcar.

Numerous high-speed long-distance journeys have been made on the various systems of France with the Micheline pneumatic-tyred railcar illustrated in Fig. 12.

The vehicle comprises a driving bogie of three axles, of which the two leading ones are driven, whilst the other is a carrying-axle only. The engine is a 140-H.P. Hispano-Suiza, running at 2200 r.p.m. The Lockhead system of hydraulic braking is applied to all wheels. The rear carrying-bogie has two axles only and is also fitted with the same system of braking as the driving bogie. Suspension of both bogies is by leaf-springs.

The body of the car is composed of a built-up framework of welded

steel tubes, suspended over the rear bogie by means of ball-jointed connecting links, and the front bogie by roller guides. It is divided into three sections: (1) A stream-line driving compartment with two doors and two or four seats; (2) a passenger compartment with seating for sixteen passengers, provided with two doors and a toilet compartment; (3) a stream-line rear end covering the trailing bogie, and used as a luggage compartment and housing two spare wheels. The roof is heat insulated and fitted with ventilators; electric lighting is provided.

The approximate dimensions are: length, 54 ft. 4 in.; width, 8 ft.; height above rail level, 9 ft. 2 in.



FIG 12—MICHELIN HIGH-SPEED PNEUMATIC-TYRED RAILCAR

The connection of the driving bogie is made by a welded-steel tube framework, articulated on one side to a pivot located approximately at the centre of inertia of the bogie, and on the other to the main longitudinal members of the body. To the rear-carrying bogie the connection is by a pivot situated slightly forward of the point of suspension of the luggage compartment. The pressed-steel disc wheels have a steel guiding flange silenced by means of a rubber insert, while the special Michelin pneumatic tyres have an outside diameter of 34 in., with a normal inflation pressure of 85 lbs. per sq. in.

The weight of the car empty is 5 tons 14 cwt. and the maximum useful load, including 5 cwt. of luggage, is 28½ cwt.

As to speed performances, the acceleration on the level in one mile was 63 m.p.h. and the maximum speed on a straight road 75 m.p.h. Speed limit on a 25-chain curve 56 m.p.h. The minimum curve to be worked round is 5-chains radius. Braking on the level at 50 m.p.h.

the normal stop is 220 yards, but an emergency stop on a dry rail can be made in 100 yards.

The machine affords very comfortable riding with a very good look-out.

Fuel consumption averages 9 to 9.5 miles per gallon.

On one of the long-distance trials from Paris to Lille, the distance of 161 miles was covered in 2 hours 27 minutes, or an average of 65.6 m.p.h. as compared with 58.7 m.p.h., the average speed of the best train. During the first hour from the start at the Nord station, Paris, the distance covered was 68 miles.



FIG 13.—2-D₀-2 TYPE ELECTRIC LOCOMOTIVE, MIDI RAILWAY

High-speed Electric Locomotives.

Of the 2-D₀-2 wheel arrangement (Fig. 13), the new machines are intended for service speeds up to the French legal maximum of 75 m.p.h., but on test and special trips they will be run up to 81 m.p.h. (130 km.p.h.). Arranged to work on 1500 volts direct current, the continuous capacity of each locomotive is no less than 3200 horse-power, which is more than sufficient to work 650-ton trains on the fastest Midi schedules, including that of the Sud Express, which now runs over the P.-O. and Midi systems from Paris to Dax at an average speed of 56 m.p.h. for the 451 miles.

The control is of the electro-pneumatic type, and the motors are entirely spring-borne, the design of the drive, and that of the locomotive

generally, being the outcome of the experience gained with the earlier 2-C₀-2 2100 horse-power machines, and with the P.L.M. 5400 horse-power express locomotive at the time the latter ran extensive trials on the Pyrenees lines of the Midi.

In working order the total weight is 120 tons, of which 75 tons are available for adhesion, while the maximum tractive effort is 50,000 lbs., and the length over buffers, 55 ft. 2 in. Westinghouse brakes operate blocks on all driving and bogie wheels, and the electrically driven compressor also supplies air to the sanding gear, which is of a very complete nature, pipes leading to each side of all driving wheels.

Electric Battery Locomotives.

For shunting and sorting wagons in goods-yards, especially where the duty is intermittent, battery-driven locomotives can be operated economically. On electrified systems the complication and expense of electrifying goods-yards and shunting-yards is considerable, the battery locomotive provides the simplest solution of this difficulty. Frequently a combined battery and trolley-operated locomotive is used on electrified systems where part of the line is unsuitable for overhead construction. For operation amongst combustible and explosive materials, wooden sheds, timber-yards and the like the battery locomotive possesses obvious advantages.

High speeds are generally unnecessary in goods-yards, and a maximum speed of six to seven miles an hour at full load and twelve miles an hour light is considered ample.

A typical specification for a locomotive suitable for shunting and heavy-work duty would be as follows:

Gauge, standard.

Weight, up to 30 tons.

Wheel-base, 6 to 8 ft.

Maximum tractive effort, 13,000 lbs.

Battery capacity, up to 160 K.W. hours at the 5-hour rate of discharge.

Battery voltage, 200 (108 cells).

H.P., at one-hour rating, up to 90.

An example which may be quoted is a locomotive belonging to the L.M.S.R. for work in the West India Docks, Coal Department, London.

Articulated Electric Trains.

The trains illustrated (Figs. 14 and 15) are for suburban traffic between Madras and Tambaram. The whole of the electric traction and control installation has been supplied and fitted by the English

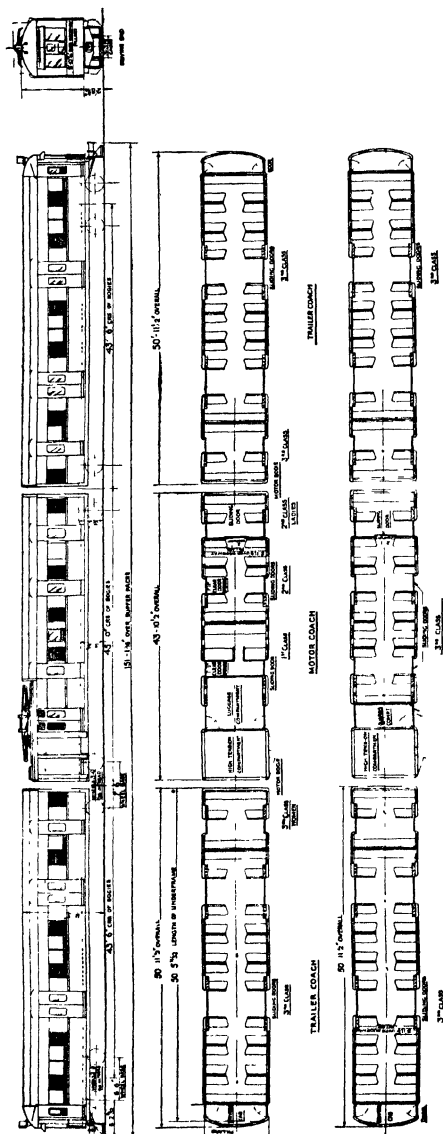


FIG. 14.—ELEVATION AND PLANS OF NEW ARTICULATED ELECTRIC TRAINS, SOUTH INDIAN RAILWAY, METRE GAUGE.

Electric Company. Each consists of one trailer coach at each end with a motor-coach in the centre, and is carried on four bogies, the motor-car being articulated at each end to a trailer. Two motor-bogies are provided, which are fitted under the articulated end of the motor-car and the two trailer cars. At the extreme ends of the train are two trailer bogies.

Certain of the units are composites, with accommodation for first-, second-, and third-class passengers, and the remaining units comprise all third-class accommodation.

Each of the composite units seats 7 first-class, 30 second-class, and 144 third-class passengers, while each third-class train seats 194 passengers.



FIG. 15.—NEW ARTICULATED ELECTRIC TRAIN, SOUTH INDIAN RAILWAY

This stock is identical in lay-out with stock already in service on the South Indian Railway, but it was considered possible to save weight by carefully scrutinizing details.

Exterior panels were reduced in thickness and the weight of all interior finish was reduced. Considerable weight was saved on the floors by the use of Lewis' "Lightweight" dovetail sheets instead of the standard type, the saving being in the weight of the steel sheets, and also the amount of floor composition.

As a result of a large number of experiments and tests made it was decided to weld up the joints of the under-frame and bogie members, and to replace steel castings with fabricated welded parts. In tests made on a riveted joint of the crossbars and solebar with knee and gusset, as compared with a welded joint without gusset, it was found that with more than double the load taken to completely cripple the riveted joint the welded joint showed no sign of damage, but the channels forming the test piece collapsed and ended the test.

The bogie solebars, instead of being built up with plates and angles, had their flanges welded to the web plate, and considerable weight was saved by substituting fabricated details for heavy castings, which had been used previously. About 4 cwt. were saved in castings alone on each motor-bogie.

The under-frames were re-designed, with the idea of saving weight in every possible direction without sacrificing the strength of the detail work or the structure. All detail ironwork was carefully scrutinized; for example, the brake shafts were made of solid-drawn steel tubes with the brake levers welded on, and the weight was thus reduced by $1\frac{1}{2}$ cwt. Brake reservoirs had brackets welded to them, by which they were bolted to the under-frames. The weight thus saved on straps, etc., amounted to $\frac{3}{4}$ cwt. The total saving on the under-frames alone amounted to nearly two tons per train.

The vacuum-brakes were supplied by the Westinghouse Brake Co. Ltd. The brake cylinders are carried on the trailer car under-frame, an 18-in. diameter cylinder, with reservoir 22 in. diameter by 26 in. long, being fitted to operate the brakes on each trailer bogie, and a 24-in. cylinder, with reservoir 22 in. diameter by 54 in. long, to operate on the motor-bogie. The cylinders are made of steel to reduce weight. The vacuum-brake system is operated through a single train pipe-line, and so arranged that the brakes on a 3-coach unit can be fully released within ten seconds after complete destruction of the vacuum. In order to prevent snatching when the brakes are applied, the brake pressures and rigging are arranged so that the brake application on all bogies is synchronized.

Screw-brakes with geared hand-wheels are fitted in the driver's compartments and operate only on the trailer bogie.

The electric-lighting batteries are carried on the motor-car under-frame in pressed-steel battery boxes, which are made as light as possible consistent with strength. There are four boxes each containing five two-cell crates of nickel-iron cells.

To improve the running, the trailer bogies have been re-designed, the main alterations being to the springing and suspension of the bolster. The bolsters are now supported on coil springs, instead of elliptic springs as before, in order to improve the running of the bogies. The bolster swing-links have been lengthened as much as possible and inclined to an angle which has been found to give the best control of the side movements of the bolster. In addition to this, side control springs have been fitted which are easily adjustable to give a wide range of control loads. These springs can be also easily put out of action if desired, and it is pro-

posed to adjust them to give the best riding of the bogies it is possible to obtain. In order to check the movements of all the bearing-springs and also the swing of the bolster, recording devices have been fitted to two of the bogies, and it is hoped that valuable data will be forthcoming when the records are examined.

The motor-bogie is generally similar to those already in use on the South Indian Railway, with the exception that the frames have been lightened and all detail ironwork and castings have been re-designed with a view to saving weight.

The axle-boxes are of the Isothermos type, and were supplied by Armstrong, Whitworth & Co. These axle-boxes, which are designed to give perfect lubrication at low and high speeds, are the result of extensive experiments.

Below is a comparison of the weights of the stock illustrated with those of the stock previously put into service.

	New Stock.				Old Stock.				Reduction.			
	T.	c.	q.	lbs.	T.	c.	q.	lbs.	T.	c.	q.	lbs.
Trailer body and under-frame .	11	4	1	1	13	16	1	15	2	12	0	14
Compo motor body and under-frame	14	19	0	0	17	11	3	18	2	12	3	18
Third-class motor body and under-frame	14	13	1	0	17	3	3	18	2	10	2	18
Trailer bogie	3	11	2	0	3	18	0	0	0	6	2	0
Motor-bogie	9	7	2	21	10	0	0	0	0	12	1	7
									T.	c.	q.	lbs.
Total weight of composite train									63	5	3	16
Total weight of third-class train									63	0	0	16
Saving in weight in composite train									9	14	3	4
Saving in weight in third-class train									9	12	2	4

With these trains the weights have been reduced sufficiently for a trailer to be attached to provide extra accommodation during rush hours without overloading the driving motors.

At each end of the train is a driver's compartment with controller, brake-valve, horn, driver's tip-up seat, steel locker, two driving mirrors, and switchboard. The driver's window is of "Armour Plate" glass, and equipped with a "Whipple" screen-wiper. Sun visors are arranged over the windows of this compartment.

Cow-catchers are provided at each end of the train, also draw- and buffing-gear, of I.R.C.M. metre-gauge type. The provision of this draw-gear enables two 3-coach units to be coupled as a 6-coach train during rush hours.

At one end of the motor-car a pantograph is fitted above the roof to pick up the current from overhead wires to the high-tension chamber, which is provided with motor-generator set, exhauster, main control frame and other electrical equipment. The doors of this compartment are so arranged that it is impossible to enter while the current is on, and are interlocked with the pantograph operating gear, so that the pantograph must be lowered away from the overhead wires before any entry can be gained. The exhauster set draws air from the exterior of the body end and the guard's compartment, through "Visco" air-filters, and forces it through suitable ducts to ventilate the traction motors fitted on the motor-bogies. The exhauster also works in conjunction with the vacuum-brake equipment.

Each light opening is fitted with a louvre frame, the first-class openings being fitted with glass frames, and all lights and louvres are arranged to drop to open.

In the trailer coaches entry is obtained by four pairs of double sliding doors and two single sliding doors, whilst in both the types of motor-car single sliding doors are used. All entrance doors are glazed. The driver's doors in the trailer coach are of the swing type with drop louvre, and in the luggage compartments of the motor-coaches a hinged door, working in conjunction with a sliding door, is fitted at each doorway opening.

The body is of steel throughout, the pillars being of channel and trough section in pressed steel. The waist rails, cant-rails, and horizontal framing rail are of rolled sections, the roof carlines are of pressed-steel channel and the roof purlins are of angle section. Steel body panels are used throughout for outside sheeting.

The bulk of the rivets are snap head on the exterior, countersunk rivets being utilized in mouldings and plates over $\frac{1}{8}$ in. thick.

The ceilings are of asbestos sheeting with an air-space between this and the outer steel roof-sheets. The ceilings are also insulated from the outside heat by means of "glass silk," which is cemented to the back of the asbestos sheets. Rotor ventilators are fitted to the roofs, the bulk of these extracting air from the compartments, whilst others extract from the air-space between ceiling and roof-sheet. Owing to the free air-space in the body side no insulation, except in the high-tension compartment which is lined with asbestos sheets, was considered necessary, but the whole of the steel framing and backs of the steel panelling were treated with Carbolastic, which also acts as a preventative to corrosion and drumming of the panels.

CHAPTER XVIII

Modern Types of Steam Locomotives

Mixed Traffic Locomotive, London, Midland & Scottish Railway.

THE engine illustrated is one of a number recently built for the London, Midland & Scottish Railway from the designs of Mr. W. A. Stanier, chief mechanical engineer. The tapered type of boiler barrel has been adopted, and the working pressure has been fixed at 225 lbs. per sq. in.,

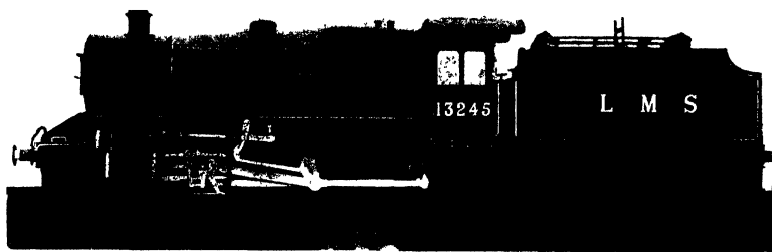


FIG 1—MIXED TRAFFIC LOCOMOTIVE, LONDON, MIDLAND & SCOTTISH RAILWAY

whereas earlier engines worked at 180 lbs. per sq. in. The boiler barrel is 11 ft. 10 $\frac{1}{16}$ in. long, with an outside diameter of 5 ft., increasing to 5 ft. 8 $\frac{3}{8}$ in. The fire-box is 9 ft. 3 in. long and the grate area 27.8 sq. ft. The superheater has been proportioned to give a moderate degree of superheat, and the main regulator has been incorporated in the superheater header in the smoke-box. Heating surface amounts to 1411 sq. ft., comprising 1256 sq. ft. tubes and 155 sq. ft. fire-box, while the superheater area is 193 sq. ft. There are 14 superheater elements, 1 $\frac{3}{8}$ in. in diameter outside by 13 S.W.G.; 14 large flues 5 $\frac{1}{4}$ in. diameter outside by 7 S.W.G., and 160 smoke-tubes 2 in. diameter outside by 11.5 S.W.G.; the distance between tube-plates is 12 ft. 3 in. The feed-water is supplied through top feed-valves arranged on the second ring of the boiler barrel, with water-distributing trays. Two

"pop" safety valves, $2\frac{1}{2}$ in. diameter, are fitted on the crown of the fire-box. A steam manifold (with main shut-off valve) is provided on the top of the fire-box back-plate, in the cab, on which are arranged the valves for ejector and steam brake, feed injectors, carriage heating, whistle and pressure gauge. A sliding fire-door is provided. On the fireman's side (right-hand side) a Davies & Metcalfe exhaust steam injector (10 mm. cones) is fitted, and on the other side a Gresham & Craven live steam injector (10 mm. cones). Other necessary boiler mountings, such as the water-gauge frames and protectors, etc., are of the railway's standard pattern.

The two outside cylinders are 18 in. diameter by 28-in. stroke, as against 21 in. by 26 in. on the earlier engines, these dimensions being possible owing to the use of increased working pressure. Further, the provision of smaller diameter cylinders has allowed these to be arranged horizontally, resulting in a more compact arrangement.

The piston valves and cylinders are provided with mechanical lubrication and steam atomizers to each point of delivery, and the piston-rod packings (which are of the cast-iron type) and valve spindle bushes have also mechanical lubrication. Five engines of the series are fitted with hydrostatic lubricators for the cylinders, for trial purposes.

The coupling and connecting rods and motion are of high tensile manganese molybdenum steel, the connecting rods being of fluted section, but the coupling rods are of rectangular section.

The wheel-centres are steel castings with the rims of triangular section, with tyre-retaining rings of the Gibson type. The balance-weights for the coupled wheels are built up by steel plates on both sides of the spokes, and riveted, the requisite weight being provided by filling in between the plates with lead. The coupled wheels are 5 ft. 6 in. in diameter.

Steel axle-boxes for the coupled wheels with pressed-in brasses have white metal pockets and oil grooves provided on both sides of the crown to ensure a thorough distribution of oil to the journal. The axle-box underkeep carries an efficient oil-pad, which can be examined by sliding out the underkeep while the axle-box is in position. The coupled wheels each have an independent mechanical oil-feed to the crown of the box with the standard back pressure valve and flexible oil-pipe connection.

All the coupled, truck and tender springs are of carbon steel, plain section, and with cotter fixing in the buckle on engine springs only. The spring links are of adjustable type on the engine, and solid type on the tender.

The leading truck is of the Bissel pattern, and the anchor pin is attached to a cross-stretcher between the main frames, 6 ft. $7\frac{3}{4}$ in. behind the truck wheel-centre. The weight on the truck is taken through side bolsters, and the bogie side check-spring gear has been arranged to ensure as smooth riding as possible.

The cab is of the standard width of 8 ft. 6 in., with the "drive" arranged on the left-hand side with the controls convenient for handling; tip-up seats are provided on each side. Two sliding windows are fitted on each side, with a hinged window on the front cab-plate.

A steam brake is fitted to the coupled wheels, and on the six tender wheels; it is controlled by the driver's vacuum-brake valve. A vacuum pump is fitted under the left-hand bottom slide-bar, driven from the crosshead.

Steam sanding is provided to the front of the leading coupled wheels and to the front and back of the driving wheels.

Standard train-heating apparatus is provided for use with passenger trains.

At 85 per cent. of the boiler pressure the tractive effort is 26,288 lbs.

The total weight of the engine in working order is 65 tons and of the tender 42 tons 4 cwt., making the total weight of the engine and tender 107 tons 4 cwt.

The standard six-wheeled tender has a capacity for 3500 gallons of water and five tons of coal, and is equipped with water pick-up gear. A hand-brake is fitted to the tender wheels, in addition to the steam-brake.

A Re-built Atlantic Type—with Poppet Valves—London & North Eastern Railway.

This engine has been fitted with new cylinders and rotary cam poppet valve-gear mechanism of the same pattern as those used on the "Shire" class engines of the London & North Eastern Railway, with which they are interchangeable. The new cylinders are 17 in. diameter by 26-in. stroke, the poppet valves being $6\frac{1}{8}$ in. diameter both for admission and exhaust. As built, the three cylinders were $16\frac{1}{2}$ in. diameter by 26-in. stroke with $7\frac{1}{2}$ in. diameter piston valves, and three sets of Stephenson link-motion driven by eccentrics on the crank-axle, the whole of the valve-gear being inside the frames. To accommodate the new cylinders the running-board of the locomotive has been raised, and the dimension of 7 ft. 5 in. between the centre of the trailing bogie wheel and that of the leading coupled wheel has been increased to

8 ft. 5 in. The steam-pipe has been re-arranged outside the smoke-box, instead of being retained in its inside position.

The tractive effort at 85 per cent. of the boiler pressure of 175 lbs.



FIG 2—RE-BUILT ATLANTIC TYPE—WITH POPPET VALVES—LONDON & NORTH EASTERN RAILWAY

per sq. in. has been increased from 19,300 lbs. to 20,446 lbs.

Other leading particulars are:

Coupled wheels	6 ft. 10 in. diameter.
Leading bogie wheels	3 ft. 7½ in. diameter.
Trailing wheels	4 ft. diameter.
Coupled wheel-base	7 ft. 7 in.
Total engine wheel-base	30 ft. 6 in.
Boiler diameter	5 ft. 6 in.
Heating surface :	
Fire-box	185 sq. ft.
Tubes	1112.5 sq. ft.
Superheater flues	534.5 sq. ft.
Evaporative total	1832.0 sq. ft.
Superheater	437.0 sq. ft.
Combined total	2269 sq. ft.
Grate area	27 sq. ft.

In working trim the engine weighs 76 tons 2 cwt.

The tender is of the six-wheeled type with a water tank of 4125 gallons and a coal bunker capacity of 5½ tons; weight, 47 tons. Weight of engine and tender is 123 tons 2 cwt., of which 41 tons 10 cwt. are available for adhesion.

Three-cylinder Tank Locomotive for the London, Midland & Scottish Railway.

This engine has the same wheel arrangement as that of existing two-cylinder 2-6-4 tank engines, but it is somewhat more powerful,

the three-cylinder type having been adopted as a means of ensuring high acceleration.

A taper pattern boiler barrel has been provided, and the working pressure is 200 lbs. per sq. in. The superheater has been proportioned to give a moderate degree of superheat, and the main regulator has been incorporated in the superheater header in the smoke-box.

A steam manifold (with a main shut-off valve) is provided high up on the fire-box front in the cab, on which are provided the necessary valves for the ejector and steam-brake, feed injectors, carriage warming, whistle, pressure gauge and sight-feed lubricator to regulator.

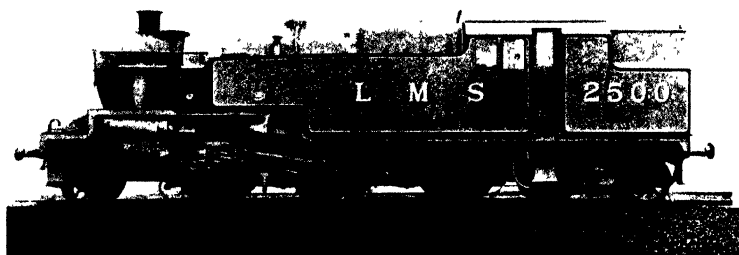


FIG 3—THREE-CYLINDER TANK LOCOMOTIVE, LONDON, MIDLAND & SCOTTISH RAILWAY

The boiler feed-water is supplied through top feed-valves provided on the second boiler ring with water-distributing trays.

The tractive effort of 85 per cent. of the boiler pressure is estimated at 24,600 lbs.

The boiler has the following dimensions:

Barrel—Length, 11 ft. 10 $\frac{1}{4}$ in. ; diameter outside, 4 ft. 9 in. increasing to 5 ft. 3 in.

Fire-box—Outside, 8 ft. by 4 ft. 0 $\frac{1}{2}$ in. ; inside, 7 ft. 3 $\frac{1}{6}$ in. by 3 ft. 4 $\frac{1}{2}$ in. ; height, 6 ft. 4 in. and 4 ft. 5 $\frac{1}{2}$ in.

Tubes—12 Superheater elements 1 $\frac{3}{8}$ in. diameter outside by 13 S.W.G. ; 12 large tubes 5 $\frac{1}{8}$ in. diameter outside by 7 S.W.G. ; 145 small tubes 1 $\frac{1}{4}$ in. diameter outside by 11 S.W.G. Distance between tube-plates, 12 ft. 3 in.

Heating surface—Tubes, 1011 sq. ft. ; fire-box, 137 sq. ft. ; superheater, 160 sq. ft. Total, 1148 sq. ft.

Grate area, 25 sq. ft.

Two “pop” type safety valves, 2 $\frac{1}{2}$ in. diameter, are fitted on the

crown of the fire-box. A standard type of sliding fire-door is provided with a screen to hide the glare from the fire. An exhaust steam injector (9 mm. cones) is fitted on the fireman's side (right-hand side), and on the other side a live steam injector (10 mm. cones) is fitted. Other boiler mountings, such as water-gauge frames and protectors, etc., are of standard type.

The three cylinders are each 16 in. diameter by 26-in. stroke. The motion for the outside cylinders provides for the double type of slide-bar, but for the inside motion a single slide-bar is provided, this being necessary to accommodate the Walschaert gear, and to clear the leading straight axle of the front drivers.

The piston valves, cylinders and piston-rod packings are provided with mechanical lubrication. The valve spindle bushes also have mechanical lubrication.

The coupling and connecting rods and motion are of high tensile manganese molybdenum steel, the connecting rods being of fluted section, but the coupling rods are of rectangular section.

The wheel-centres are steel castings with the wheel rim of triangular section, and the tyre retaining rings are of the "Gibson" type.

Axle-boxes for the coupled wheels are steel castings with pressed-in brasses with white metal crown, and oil grooves provided on both sides of the crown, to ensure a thorough distribution of oil to the journal. The axle-box underkeep carries an oil-pad.

The leading and trailing axle-boxes are arranged so that the oil-pads can be examined by sliding out the underkeep while the axle-box is in position. This arrangement, however, cannot be provided on the middle-coupled axle-boxes on account of the crank-axle and eccentrics. Each of the axle-boxes is provided with a dust shield, carried on the inside face of the box. A separate mechanical lubricator supplies the coupled axle-boxes, each of which has an independent oil feed to the crown of the box, with the standard back pressure valve and flexible oil-pipe connection.

All laminated bearings for the engine are made of silico manganese steel, the plates being of a ribbed section, and with the cotter type fixing in the buckle; the spring links are of the screwed adjustable type.

The two-wheeled leading truck is of the Bissel type, and the anchor pin is attached to a cross-stretcher between the main frames, 6 ft. 7½ in. behind the truck wheel-centre. The weight on the truck is taken through side bolsters.

The trailing bogie is of standard four-wheeled pattern, the weight

being taken through side bolsters ; the bogie side check-spring gear is of a very flexible type and, as in front, well arranged to ensure smooth running.

The cab is of the completely closed type; the width over the cab and side tanks is 8 ft. 10½ in. The drive is on the left-hand side, and all controls are arranged for convenient handling. Tip-up seats are fitted on each side of the cab. Two sliding windows are fitted on each side, and hinged windows are provided on the cab front-plate, and also in the cab back-plate. A feature is the narrowing of the coal-bunker at the top so that a clear look-out is provided when the engine is running bunker first.

A steam-brake is fitted to the coupled wheels controlled by the driver's vacuum-brake valve. A vacuum-pump is carried on the inside motion-plate and is driven from a suitable connection taken from the inside crosshead. When standing, a small ejector maintains the vacuum on the engine and train; a hand-brake is provided as usual.

The sanding gear is of the mechanical trickle type, the sand being delivered to the front of the leading coupled wheels and front and back of middle coupled wheels. In addition to this, a water de-sanding apparatus is provided which automatically comes into action so that after the engine has used the sand in the fore or reverse direction, as the case may be, the rails are cleaned with hot water to prevent interference with track circuits and signals.

The standard carriage-warming apparatus is provided with connections at the front and rear of the engine.

The water capacity is 2000 gallons, and the coal-bunker carries 3½ tons, the latter is arranged to be self-trimming as far as possible. The total weight, in working order, is 92 tons 10 cwt., and light 74 tons 2 cwt.

Three-cylinder 4-6-0 Passenger Express Engine, London, Midland & Scottish Railway.

The three cylinders of this series of locomotives are 17 in. diameter by 26-in. stroke, with separate sets of Walschaerts motion. A travel of 6½ in. is provided for the outside cylinders, and 6½ in. for the inside cylinder. Mechanical lubrication is provided for the piston valves, cylinders and piston-rod packings, as well as the valve spindle bushes. The lubrication of each piston valve-head is provided with a steam atomizer. High tensile manganese molybdenum steel is used for the motion, coupling and connecting rods; the latter are of fluted section, whilst the coupling rods are of rectangular section. The cast-steel

wheel-centres have rims of triangular section, and the tyres are fastened by Gibson retaining rings. The axle-boxes for the coupled wheels are of cast-steel with pressed-in brasses having white metal crowns with oil grooves. The underkeeps carry efficient oil pads, which can be examined by sliding out, in the middle and trailing axle-boxes, while these are in position. This arrangement cannot be used on the leading coupled axle-boxes on account of the crank-axle and eccentrics. a separate mechanical lubricator supplies the coupled axle-boxes, each having an independent feed. All the bearing-springs are of silico

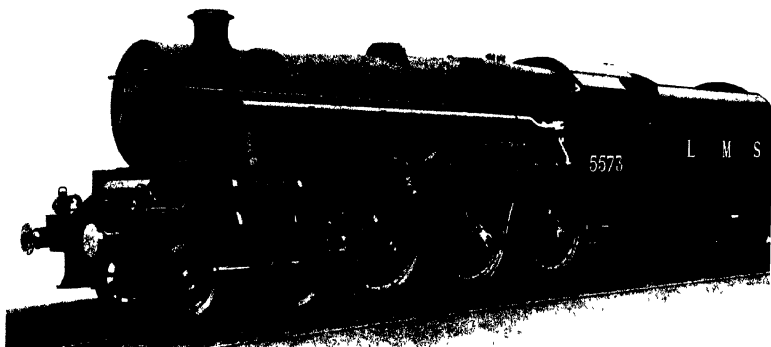


FIG. 4.—THREE-CYLINDER 4-6-0 EXPRESS LOCOMOTIVE, LONDON, MIDLAND & SCOTTISH RAILWAY.

manganese steel, the plates being of ribbed section, and with cotter type fixing in the buckle.

The cab is 8 ft. 6 in. wide, with the drive on the left-hand side; tip-up seats are fitted on each side. Two sliding windows are fitted on each side of the cab and hinged windows in front. On each side of the cab a small hinged window, which acts as a draught-preventer for the engine-men when looking out, is provided.

2-8-2 Express Locomotive, London & North Eastern Railway.

In addition to the particulars enumerated in the table which accompanies this description, there are several interesting points in the design which must be mentioned. On the top of the barrel of the boiler is a steam collector, which is integral with the dome, and formed

of a steel-pressing riveted to the top of the boiler on the outside. Steam is admitted to this collector by means of a number of slots cut in the top of the boiler barrel, the object being to prevent water being carried over with the steam. The boiler has a 43-element M.L.S. superheater with "Sinuflo" element tubes, the return bends of the element tubes being brought to within 9 in. of the fire-box tube-plate. The three cylinders, 21 in. diameter by 26-in. stroke, and the valve-chests are in one casting, and the 9-in. diameter piston valves are operated by Walschaert-Gresley gear of similar pattern to that fitted to the London & North Eastern Railway "Pacific" type engines.

In order to ensure that the boiler pressure can be maintained in the steam-chest, an extra large regulator and steam-pipes are provided, the main steam-pipe being 7 in. in diameter, while, in order to reduce the back pressure as much as possible, a double blast-pipe with two chimneys is fitted.

Leading dimensions and ratios:

Grate :

Length on slope	7 ft. 2 in.
Width	6 ft. 11 $\frac{3}{4}$ in.
Grate area	50 sq. ft.

Fire-box :

Height of crown above foundation ring	} front	6 ft. 8 $\frac{1}{2}$ in.
" " " " " "		6 ft. 0 $\frac{5}{8}$ in.
Interior length at top		9 ft. 2 $\frac{1}{2}$ in.
Interior width at boiler centre		5 ft. 4 $\frac{1}{2}$ in.
Thickness of copper plates	} Sides and back	1 $\frac{9}{16}$ in.
" " " " " "		1 $\frac{9}{16}$ in. & 1 $\frac{1}{4}$ in.

Boiler :

Outside length fire-box over-all	10 ft. 8 $\frac{3}{4}$ in.
" " " " at bottom	7 ft. 11 $\frac{1}{4}$ in.
Outside width fire-box at bottom	7 ft. 9 in.
Diameter of barrel, maximum	6 ft. 5 in.
Length of barrel	19 ft.
Thickness of barrel plates	3 $\frac{1}{2}$ in. & 2 $\frac{5}{8}$ in.
Thickness of wrapper plates	1 $\frac{9}{16}$ in.
Length of smoke-box at bottom	8 ft. 11 in.

Tubes, small :

Material	Steel
Number	121
Diameter outside	2 $\frac{1}{4}$ in.
Thickness	10 I.W.G.

Tubes superheater flue :

Number	43
Diameter outside	5 $\frac{1}{4}$ in.
Thickness	$\frac{5}{16}$ in.
Length between tube-plates	18 ft. 11 $\frac{1}{2}$ in.

Heating surface :

Fire-box	237 sq. ft.
Tubes, 2 $\frac{1}{4}$ in.	1354.2 sq. ft.
Flues	1122.8 sq. ft.
Total evaporative H.S.	2714.0 sq. ft.

Superheater :

Number of elements	43
Diameter inside	1 $\frac{1}{6}$ F.
Heating surface	635.5 sq. ft.

Total heating surface	3349.5 sq. ft.
Two Ross pop safety-valves	3 $\frac{1}{2}$ in. diameter
Working pressure	220 lb./sq. in.
Boiler horse-power	1777

Axles :

	Dia	Length
Journals, pony	6 $\frac{1}{2}$ in.	9 in.
Journals, coupled	9 $\frac{1}{2}$ in.	11 in.
Journals, trailing	6 in.	11 in.

Crank-pins :

Outside	6 $\frac{1}{2}$ in. $\times$ 6 in.
Inside	9 $\frac{1}{4}$ in. $\times$ 6 in.

Coupling pins :

Leading	4 $\frac{3}{4}$ in. $\times$ 4 in.
Driving	7 $\frac{1}{2}$ in. $\times$ 4 $\frac{1}{2}$ in.
Intermediate	4 $\frac{3}{4}$ in. $\times$ 5 in.
Trailing	4 $\frac{3}{4}$ in. $\times$ 5 in.

Springs :

Pony truck : Helical, 10 $\frac{3}{16}$ in. long free 5 $\frac{1}{2}$ in. outside diameter Timmis section. Coupled wheels : Laminated, 3 ft. 6 in. crs., 15 plates 5 in. wide by $\frac{7}{8}$ in. thick. Trailing wheels : Laminated, 4 ft. 6 in. crs., 14 plates 5 in. wide by $\frac{7}{8}$ in. thick.

Tractive effort at 85 per cent. boiler pressure	43,462 lbs.
Total adhesive weight	180,544 lbs.
Adhesive weight $\div$ tractive effort	4.15

The boiler barrel is standard with that used on the "Pacific" type engines of the London & North Eastern Railway, but the fire-box has been lengthened to provide a grate area of 50 sq. ft.

The front of the cab is Vee-shaped, and this has enabled larger spectacle glasses to be fitted, giving the engine-men a better look-out.

The shape of the wing-plates and the top of the smoke-box were determined by wind-tunnel experiments at the City and Guilds College, and are designed to ensure the smoke and steam from the chimneys being thrown clear of the cab at all speeds.

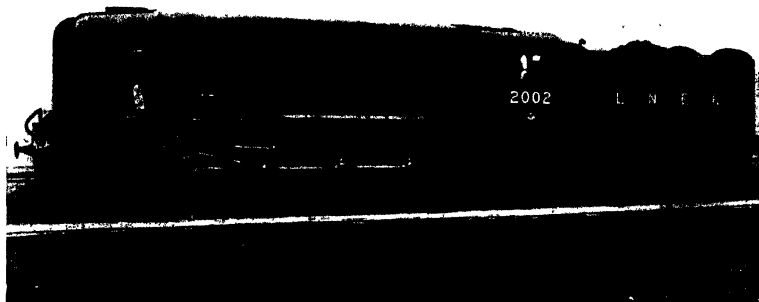


FIG. 5.—2-8-2 EXPRESS LOCOMOTIVE, LONDON & NORTH EASTERN RAILWAY.

The trailing wheels are fitted with Cortazzi axle-boxes.

The tender is of the same design as those fitted to the latest "Pacific" type engines, but not of the corridor type.

2-8-2 Heavy Goods Tank Locomotive, Great Western Railway.

These engines were originally built as 2-8-0 tank engines, "5200" class, and were specially designed for dealing with the South Wales coal traffic from the pits to port of shipment. Owing, however, to the falling-off in the export coal trade, they were no longer required for this service, and were converted at Swindon to the 2-8-2 type, having larger coal and water capacity to make them suitable for main line service, in replacement of 2-6-0 mineral tender engines.

The trailing radial truck is of standard design, but has increased side-play to enable sharp curves to be negotiated.

The principal dimensions are as follows:

Two cylinders, 19 in. diameter by 30-in. stroke.

Coupled wheels, 4 ft. $7\frac{1}{2}$ in. diameter.

Leading pony truck wheels, 3 ft. 2 in. diameter.

Trailing radial truck wheels, 3 ft. 8 in. diameter.

Working pressure, 200 lbs. per sq. in.

Boiler—Barrel, 11 ft. long; diameter outside, 4 ft. $10\frac{3}{4}$ in. and 5 ft. 6 in.

Tubes—84 superheater tubes, 1 in. diameter, 11 ft. $5\frac{1}{2}$ in. long; 14 fire-tubes at $5\frac{1}{4}$ in. diameter; 235 at $1\frac{1}{4}$ in. diameter; length, 11 ft. $4\frac{7}{8}$ in.

Fire-box—Outside, 7 ft. by 5 ft. 9 in. and 4 ft.; inside, 6 ft. $2\frac{1}{2}$ in. by 4 ft. $8\frac{7}{8}$ in. and 3 ft. $2\frac{1}{8}$ in.

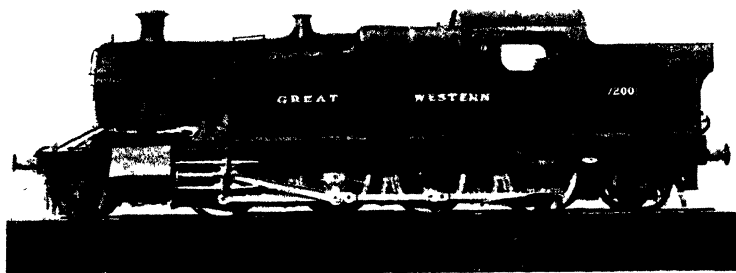


FIG 6—2-8-2 HEAVY GOODS TANK LOCOMOTIVE, GREAT WESTERN RAILWAY

Heating surface :

Superheater tubes	191.79 sq. ft.
Fire-tubes	1349.64 „
Fire-box tubes	128.72 „
Total	<u>1670.15 sq. ft.</u>

Grate area	20.56 sq. ft.
Water capacity.	2500 gallons.
Coal capacity of bunker	6 tons.
Tractive effort	33,170 lbs.

The total wheel-base is 35 ft. 3 in. and the coupled-base 20 ft., whilst the length over buffers is 44 ft. 10 in., this being the longest tank engine on the Great Western Railway at the time of writing.

Pacific Type Locomotive, Tientsin-Pekin-Pukow Railway.

A typical 4-6-2 locomotive for foreign service is shown in the accompanying photograph. These engines, constructed by the North British Locomotive Company, are similar to previous locomotives built in America in 1920, and are fitted with the following accessories: "Hancock" inspirators, check-valves and water column, "Franklin" fire-door, multiple throttle, Westinghouse E.T. 6-brake equipment, with 8½ in. cross-compound air compressor, Westinghouse steam-

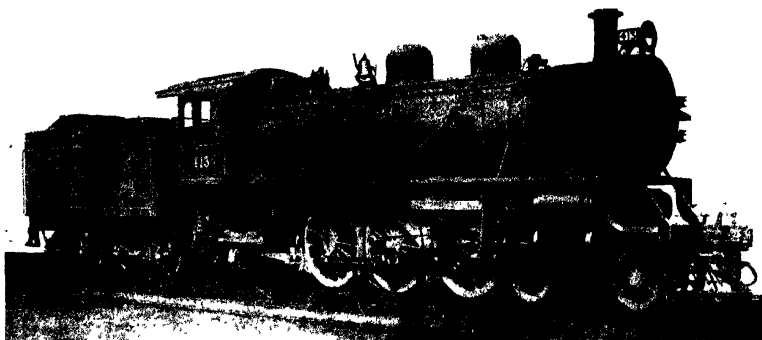


FIG 7—PACIFIC TYPE LOCOMOTIVE, TIENSIN-PEKIN-PUKOW RAILWAY, CHINA

heating equipment, A.R.A. type "D" couplers, "Bradford" rocker-type draft gear, and "Alco" power reversing gear.

The leading particulars are:

Cylinders, diameter	20 in.
Stroke	28 in.
Wheels, front bogie	3 ft. diameter.
„ coupled	5 ft. 9 in. diameter.
„ rear truck	3 ft. 6 in. diameter.
Wheel-base, rigid	12 ft.
„ total	32 ft. 1 in.
Working pressure	200 lbs. per sq. in.
Boiler heating surface :	
Tubes, small	1176 sq. ft.
„ large	546 „
„ arch	23 „
Fire-box	202 „
Total	1947 sq. ft.

LOCOMOTIVES

Superheater	443 sq. ft.
Total	2390 sq. ft.
Fire-grate area	43.5 sq. ft.
Tractive force at 75 per cent.	24,350 lbs.
" " 85 per cent.	27,000 lbs.
Weight in working order	90 tons 10 cwt.

Tender

Wheels, diameter	3 ft.
Wheel-base	17 ft. 10 in.
Tank capacity	5280 gallons.
Fuel	9.84 tons.
Weight, full	57 tons 8 cwt.

Engine and Tender

Wheel-base, total	60 ft. 4 in.
Weight, total	147 tons 18 cwt.

2-10-2 Locomotive, Turkish State Railways.

The locomotives illustrated were built by Henschel & Sohn, at Cassel, and have standard 8-wheeled tenders. The dimensions are as follows:

Cylinders, diameter	24.8 in.
Piston stroke	25.9 in.
Diameter of driving wheels	4 ft. 7 in.
Carrying wheels, diameter	3 ft. 3.375 in.
Boiler pressure, 12 atmos.	180 lbs. per sq. in.
Grate area	32.6 sq. ft.
Heating surface :	
Fire-box	178.1 sq. ft.
Tubes	1772 "
Flues	1950 "
Superheater	737.1 "
Weight, empty (tons)	81.50
Weight in working order (tons)	90
Adhesive weight (tons)	66.90
Tractive effort at 60 per cent. B.P. (lbs.)	29,700
Maximum speed (m.p.h.)	40
Capacity of water tank	3940 gallons
Capacity of coal-bunker	8 tons
Weight, empty	25.5 tons
Weight in working order	60.5 tons

With particular reference to these locomotives, the following data are of interest:

Total length, engine and tender	62 ft. 5.5 in.
Total length of locomotive	44 ft. 3.2 in.
Total height of locomotive	14 ft.
Wheelbase of coupled wheels	4 x 4 ft. 11 in.
" " front carrying axle	7 ft. 10.5 in.
" " rear " "	8 ft. 2.5 in.
Total wheel-base of locomotive	35 ft. 9 in.



FIG 8—2-10-2 LOCOMOTIVE, TURKISH STATE RAILWAYS.

These goods locomotives, having the moderate axle load of only 13.5 tons, can be used on branch lines with comparatively light permanent ways.

2-10-0 Four-cylinder Locomotive, Northern Railway of France.

Despite the modest diameter of the coupled wheels, these locomotives can deal with heavy express passenger trains, the ample adhesion weight of 90.7 metric tons in conjunction with the small wheels giving a capacity for rapid acceleration which is particularly valuable when the run includes a number of stops. A locomotive of this type in regular service between Paris and Maubeuge or Paris and Aulnoye works trains weighing over 550 metric tons behind the tender at speeds of 90 to 95 km./hr., this speed is maintained on gradients of 0.5 per cent. with a maximum of 110 km./hr. on the level.

As the coupled wheels have a diameter of but 1.550 m. (5 ft. 1 in.) these must rotate at about 375 r.p.m. at the above speed with a correspondingly high piston velocity. Thus there are two major problems

for the designer: to secure a free passage for the steam from its entering the cylinders to emission at the blast-nozzle, and the restriction to a minimum of inertial disturbances in the driving mechanism. It may be noted that with "Mikado" tank locomotives with coupled wheels of the same diameter as those of the engine now under notice, even higher speeds have been achieved, but in their case a special type of valve-gear is employed in conjunction with simple expansion in two cylinders only. The 10-coupled engines, however, have ordinary Walschaerts gear for the distribution, independently controlled sets

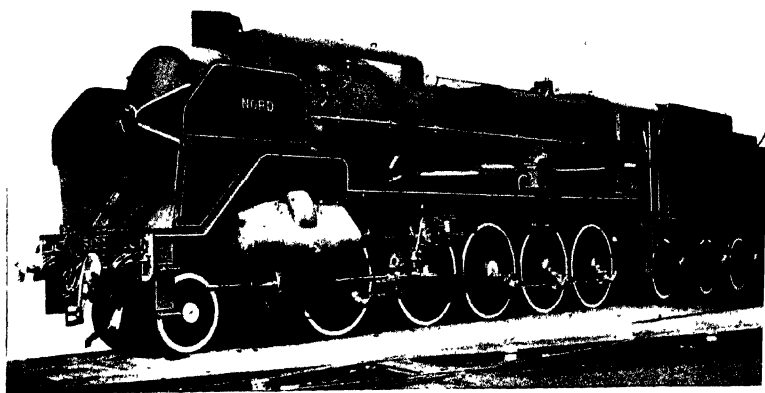


FIG. 9.—2-10-0 FOUR-CYLINDER LOCOMOTIVE, NORTHERN RAILWAY OF FRANCE

being provided for the high- and low-pressure groups, but great care has been taken to secure a large sectional area for the ports and passages, with curves of wide radius and as short as possible. The variable blast-pipe is also of large diameter, and has its nozzle placed low down in the smoke-box with "petticoats" between it and the chimney. Even at high speeds there is little drop in valve-chest pressure, and the large diameter of the piston valves allow of ample port area. Free running is of course helped by the compound principle, as an economical degree of expansion is obtained with a cut-off sufficient to avoid attenuation or excessive compression.

The cylinder blocks are steel castings with cast-iron liners. The high-pressure cylinders are external, and have a diameter of 490 mm. (19.3 in.) and piston stroke of 640 mm. (25.2 in.). They are set horizontally, and are cast integral with the front portion of the framing,

which extends to the cross-stay. The inside low-pressure cylinders, of which the diameter and piston stroke are respectively 680 mm. (26.7 in.) and 700 mm. (27.5 in.) are also formed together with their valve chambers as a monoblock steel casting. The large diameter of the inside cylinders which this construction permits will be noted, so that notwithstanding the size of the high-pressure cylinders, a piston displacement volume ratio between the high-pressure and low-pressure cylinders of 1:2:106 is obtained. A safety valve limits the pressure in the intermediate receiver to 8 h.p.z. (116 lbs. per sq. in.).

All the moving parts are remarkably light. The coupling rods, etc., are of nickel-chromium steel, and all rods are fluted. The pistons are of special steel, and the piston valves are formed from thin welded-plate. The crossheads are of the single-bar type and are also very light, but with large bearing surfaces. The effect of this careful attention to detail is revealed by the relative smallness of the balance weights, and it would seem that the track should not be subject to excessive "hammer blow" at the highest speeds contemplated.

The coupled wheels are spaced closely together and equally, 5 ft. 5.3 in. apart, save for the leading pair, which are 6 ft. 6.7 in. from their neighbours. The total coupled wheel-base has a length of 22 ft. 10.8 in., but of this only 5.320 m. (17 ft. 5.4 in.) is rigid, as the trailing pair are allowed a side-play of 15 mm. (0.6 in.) each way. The total wheel-base is 31 ft. 1.2 in., and the over-all length 41 ft. 1.3 in. The Bissel truck, of which the wheels are 0.950 m. (3 ft. 1.4 in.) in diameter, has a lateral displacement of 65 mm. (2.5 in.) and enough flexibility is given to allow passage round curves of 145 m. radius. Suspension is by means of flat laminated springs so compensated that the engine is borne upon three points, and the framing is composed of plate 45 mm. (1.7 in.) thick, braced by stretchers of cast steel. The axle-boxes and low-pressure crossheads are lubricated by force pumps, and the Bissel and draw-gear between the engine and tender by the Tecalemit grease system. The valves and pistons are hydro-mechanically lubricated with special high-temperature oil.

The boiler is similar to that of "Pacifics," series 3.1251-90, but the working pressure has been increased by 1 h.p.z. to 18 h.p.z. (261 lbs. per sq. in.) and there are some slight modifications in the number of tubes and the heating surface proportions. The grate area is 3.48² m. (37.4 sq. ft.) and the fire-box, which is of the Belpaire type, with a long and narrow grate and sloping back-sheet, has a heating surface of 20.30² m. (218 sq. ft.). The barrel is formed in two rings, with a mean internal diameter of 1.747 m. (5 ft. 8 in.) and has a length between tube-plates of 4.500 m. (14 ft. 9 in.). The tube arrangement com-

prises 36 plain tubes, 45–50 mm. (1.7–1.9 in.) diameter; 65 *Serve* tubes, 65–70 mm. (2.5–2.7 in.) diameter; and 32 flues, 135–145 mm. (5.3–5.6 in.) diameter. These latter house the elements of the Schmidt type superheater, which is arranged to give a superheat of about 380° C. in normal condition, increasing to 420° C. when the engine is working at its maximum output. The total evaporative surface is 195.98² m. (2108 sq. ft.), so that the total combined heating surface, including the 61.01² m. (656 sq. ft.) given by the superheater, amounts to 256.99² m. (2764 sq. ft.). Feed is provided by an A.C.F.I. exhaust-steam heat apparatus and by two 10 mm. injectors. Other equipment includes two “pop” safety valves, Westinghouse automatic and direct brakes with blocks acting on all coupled wheels, Leach air-sanding gear, electric lighting by turbo-generator, tachygraph, etc., and smoke-deflecting shields are fitted.

The tenders for these locomotives are of the standard Nord type, with pressed steel frames for the bogies, and welded steel tanks. They have a water capacity of 38² m. (8360 gallons) and carry 9000 kg. of fuel. The weight is approximately 77 metric tons when fully laden, thus making a total weight for engine and tender of about 181 metric tons.

4-8-4 Locomotive, New Zealand Government Railways.

Built to operate over the heavily-graded main lines in the North Island of New Zealand, the new K class 4-8-4 type mixed traffic



FIG. 10.—4-8-4 LOCOMOTIVE, NEW ZEALAND GOVERNMENT RAILWAYS.

locomotives illustrated have effected considerable economies in working. When in many cases double heading was formerly necessary, these locomotives can keep time with similar trains unaided.

The engines have been constructed to the designs of Mr. P. R. Angus, chief mechanical engineer of the New Zealand Government Railways. The first of the series, No. 900, was fitted with a draught-deflector on the chimney, and is the one illustrated here.

The tractive effort at 80 per cent. of the boiler pressure is 30,815 lbs.

The coupled wheels are 4 ft. 6 in. The cylinders are 20 in. diameter by 28-in. stroke. Coupled wheel-base is 14 ft. 3 in. and the total wheel-base, 6 ft. 10½ in.

Heating surface—tubes and flues, 1741 sq. ft.; fire-box, 190 sq. ft.; superheater, 482 sq. ft.; grate area, 47·7 sq. ft. Working pressure, 200 lbs. per sq. in. The engines are fitted with the Superheater Company's multiple valve regulator header. Tank capacity of tender, 5000 gallons; coal space, 310 cub. ft., or 7¾ tons. Adhesive weight, 53 tons 12 cwt. Total weight in working order (without booster), engine and tender, 134 tons 16 cwt.

Four-cylinder 4-6-2 Passenger Express Locomotive, London, Midland & Scottish Railway.

A series of express engines were put into service on this railway during 1935, which must be mentioned. The illustration (Fig. 11) of

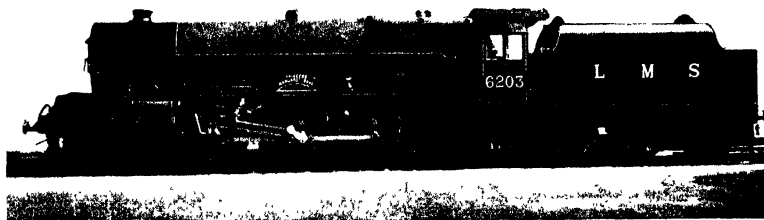


FIG. 11.—4-6-2 FOUR-CYLINDER EXPRESS LOCOMOTIVE, LONDON, MIDLAND & SCOTTISH RAILWAY

No. 6203, named "Princess Margaret Rose," shows the first of the class, and will assist in following the leading characteristics. The design is generally based on two prototypes, put into service in 1933—No. 6200, "Princess Royal," and No. 6201, "Princess Elizabeth";

and to enable comparison to be made the chief dimensions are given in tabulated form:

	Nos 6200 and 6201.	Nos. 6203-6212.
4 cylinders, diameter $\times$ stroke ins.	$16\frac{1}{2} \times 28$	$16\frac{1}{2} \times 28$
Valve travel—Walschaert's gear	$7\frac{1}{2}$ ins.	$7\frac{1}{2}$ ins.
6-coupled driving wheels	6 ft. 6 in.	6 ft. 6 in.
Working pressure of boiler—per sq. in.	250 lbs.	250 lbs.
Heating surface of fire-box	190 sq. ft.	217 sq. ft.
„ „ tubes	2523 „	2097 „
Total	2713	2314
„ „ superheater	370	653
Grate area	45 sq. ft.	45 sq. ft.
Tractive effort—lbs. at 85% of boiler pressure	40,300	40,300

The increase in the heating surface of the fire-box will be noticed, as also the considerable augmentation of superheater. To secure the additional surface to the fire-box, the forward portion has been adapted to form a combustion chamber, whilst the superheater flues have been increased from 16 to 32 in number.

The feed arrangements have been specially studied: a Davies & Metcalfe exhaust injector is provided on the right-hand side and a live steam one on the left; both deliver the feed through top clack valves. Sliding trays are fitted beneath the water delivery nozzles inside the boiler to enable periodic removal of deposit.

The four cylinders are each $16\frac{1}{2}$ in. diameter by 28 in. stroke, with piston valves 8 in. diameter, with a stroke of $7\frac{1}{2}$ in., actuated by Walschaert's motion. Roller bearings are applied to the motion pins of the valve-gear, with the exception of the driving bearing of the outside eccentric rods which are fitted with "Skefko" double row self-aligning radial ball-bearings.

The trailing two-wheeled Bissel trucks of five of these engines are fitted with roller bearings, the remaining five having plain bearings.

The tenders are larger than the ones fitted to the two earlier engines.

Each tender is carried on six wheels, with a wheel-base of 15 ft., and has a capacity for 4000 gallons of water and 9 tons of coal.

The coal bunker has been designed so that the coal will be self-trimming, as far as possible. A door is arranged to give access to the coal space from the engine footplate, and there are commodious tool-boxes on the tender front.

On the left-hand side a cavity is arranged for the accommodation of the fire-irons.

Hand-brake apparatus is fitted to the tender wheels, in addition to the steam brake.

Both the water pick-up and tender hand-brake handles are arranged vertically, with bevel wheels to transmit the motion to its particular mechanism.

Stream-lined Locomotives.

The modern tendency to build all moving vehicles, etc., designed for high speed with stream-lined outlines to reduce resistance has had

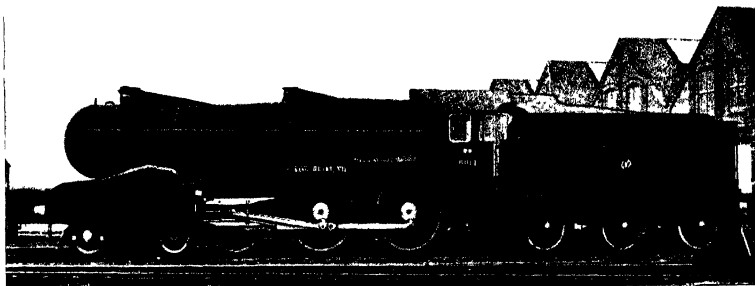


FIG. 12—4-6-0 FOUR-CYLINDER EXPRESS LOCOMOTIVE, GREAT WESTERN RAILWAY

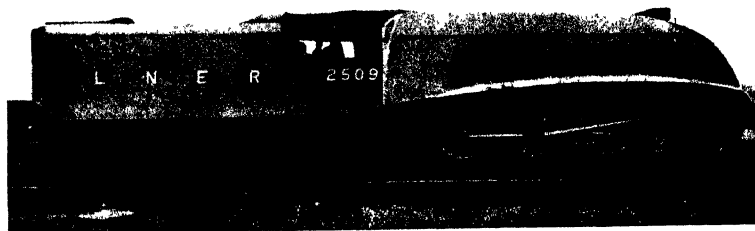


FIG. 13—4-6-2 THREE-CYLINDER EXPRESS LOCOMOTIVE, LONDON & NORTH-EASTERN RAILWAY

its effect on steam locomotives and railway trains, and illustrations of examples put into service on railways in this country from photographs of locomotives on the Great Western and London & North Eastern Railways are reproduced. The first (Fig. 15) illustrates the "King

Henry," a 4-6-0 of the Great Western Railway, fitted with screens and deflectors with the object of reducing and effecting economy in coal consumption. The second photograph (Fig. 13) shows one of the 4-6-2 express locomotives, No. 2509, "Silver Jubilee," of the London & North Eastern Railway, as covered in for service on the Silver Jubilee express between London and Newcastle. The cars forming the train are specially arranged to offer the minimum of resistance at high speeds, and conform to the outline of the locomotive.

This train is timed to run the 268 miles in 4 hours with one stop at Darlington (232 miles from London). It should be noted in reference to these stream-lined examples of locomotives that the head-on air resistance at 70 m.p.h. is approximately 50 per cent. greater than that experienced at 60 m.p.h.

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